2-A
POPULATION AND FLOW ANALYSIS

FINAL
ENVIRONMENTAL
IMPACT STATEMENT

Brightwater
Regional Wastewater
Treatment System

APPENDICES

King County Brightwater TREATMENT SYSTEM

Final

Appendix 2-A
Population and Flow Analysis

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King County
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Introduction

King County has prepared a Draft Environmental Impact Statement (Draft EIS) and Final Environmental Impact Statement (Final EIS) on the Brightwater Regional Wastewater Treatment System. The Final EIS is intended to provide decision-makers, regulatory agencies and the public with information regarding the probable significant adverse impacts of the Brightwater proposal and identify alternatives and reasonable mitigation measures.

King County Executive Ron Sims has identified a preferred alternative, which is outlined in the Final EIS. This preferred alternative is for public information only, and is not intended in any way to prejudge the County's final decision, which will be made following the issuance of the Final EIS with accompanying technical appendices, comments on the Draft EIS and responses from King County, and additional supporting information. After issuance of the Final EIS, the King County Executive will select final locations for a treatment plant, marine outfall and associated conveyances.

The County Executive authorized the preparation of a set of Technical Reports, in support of the Final EIS. These reports represent a substantial volume of additional investigation on the identified Brightwater alternatives, as appropriate, to identify probable significant adverse environmental impacts as required by the State Environmental Policy Act (SEPA). The collection of pertinent information and evaluation of impacts and mitigation measures on the Brightwater proposal is an ongoing process. The Final EIS incorporates this updated information and additional analysis of the probable significant adverse environmental impacts of the Brightwater alternatives, along with identification of reasonable mitigation measures. Additional evaluation will continue as part of meeting federal, state and local permitting requirements.

Thus, the readers of this Technical Report should take into account the preliminary nature of the data contained herein, as well as the fact that new information relating to Brightwater may become available as the permit process gets underway. It is released at this time as part of King County's commitment to share information with the public as it is being developed.

Summary

This Technical Memorandum (TM) addresses regional population and employment forecasts within the King County wastewater service area and the resulting wastewater flow that is expected to be conveyed and treated by the Brightwater Facilities. Population and employment forecasts and their effect on wastewater flows are crucial in determining when facilities must be constructed and to what capacities.

The updated methodology used to convert population and employment forecasts to flow projections is similar to that used in previous Regional Wastewater Service Plan (RWSP) and Brightwater System work. This TM is the first to compare 2000 census and employment data with the previous population and employment data used in the RWSP.

Population and employment forecasts in this study are based on the 2000 census data and the 2000 commercial and industrial employment figures provided by the Puget Sound Regional Council (PSRC). PSRC provided data for 1990 and 2000 and forecasts for 2010, 2020 and 2030. For 2040 and saturation, population and employment were extrapolated by King County by applying a linear trend function to the PSRC data provided for previous years.

For this analysis, King County developed and compared population and employment forecasts for its entire service area (Figure 1) and flow projections specifically for the RWSP Brightwater Service Area (Figure 2).

This technical memorandum contains some background information on the source of the basic population and employment planning data and how PSRC and King County generated updates to population and employment data. Also included is an overview of the methods, complexities, and assumptions involved in developing the population and employment forecasts. Furthermore, this technical memorandum addresses comparisons of 1995 population and employment data used in the RWSP with current (2000) population and employment data.

Analysis of the updated PSRC data suggests that the previous population and employment forecasts within the King County wastewater service area are similar to current (2000) population and employment forecasts for residential, commercial, and industrial categories. The implications of the preliminary updated Average Wet Weather Flow (AWWF) data are that the South Plant may reach its 115 mgd capacity earlier than projected and that Lake Forest Park and McAleer/Lyon basin flows can be diverted to West Point through 2050. Preliminary peak flow estimates at this point suggest, as in the RWSP, that we will exceed capacity in the north end conveyance and storage no later than 2010. Further, the preliminary estimates indicated that the design peak 20-year flow estimate of 170 mgd in the RWSP remains valid for the Brightwater Plant at saturation (2050).

RWSP & Brightwater Draft EIS[1] Demographic Forecasts & Wastewater Flow Projections

The Washington State Growth Management Act (GMA) requires that capital facility plans project future facility needs. This requirement is the basis for the King County Comprehensive Plan (KCCP), adopted in 1994 and subsequently amended. The KCCP established an Urban Growth Area (UGA) within which adequate services must be provided to serve population growth. The State of Washington and King and Snohomish Counties have prepared population and employment forecasts, which include information on geographic distribution. These forecasts have provided the basis in King County's RWSP to determine future flows into the King County system (refer to the RWSP for a detailed discussion of flow projections). The RWSP was developed to be consistent with the KCCP and to ensure that wastewater facilities were available to serve growth in the multiple cities included within King County's service area. The RWSP was, as part of the County's Capital Facilities Plan, incorporated into the 2000 King County Comprehensive Plan.

The timing, sizing, and location of proposed facilities under the RWSP were developed to provide adequate capacity to handle expected wastewater flows within the King County UGA. This capacity does not include the capacity to handle wastewater flows generated

[1] For a detailed discussion of population and employment forecasts, see Chapters 6, 7, and 8 or Wastewater 2020 Plus Existing Conditions, King County Department of Metropolitan Services (METRO) and HDR Engineering , Inc., August 1994.

outside the King County wastewater service area, including flows generated within isolated urban growth areas such as those in the Snoqualmie River Valley.

Local comprehensive plans for counties and cities within the King County wastewater service area have been prepared in conformance with the GMA. The RWSP, through conformance with the overall growth management process, is also therefore consistent with the goals and policies for utility service levels in local comprehensive plans. In addition, because the timing, sizing, and location of proposed facilities are based on population and employment forecasts that are also used as a basis for development of local comprehensive plans, this strategy is consistent with the growth management provisions relating to concurrency (i.e. the availability of necessary utilities and other infrastructure and services concurrent with development that depends on the infrastructure and services).

Puget Sound Regional Council (PSRC) Data

To identify future wastewater facility needs in its service area, the King County Wastewater Treatment Division projected future wastewater flows by first using population and employment forecasts provided by the Puget Sound Regional Council (PSRC). King County has used PSRC population and employment information in several previous studies.

Since 1965, the PSRC, and previous to 1991, through its predecessor, the Puget Sound Council of Governments, has developed and maintained regional economic, demographic and transportation databases for use in local, regional, and state planning. The PSRC has the responsibility for defining the regional, multi-county "vision" for Central Puget Sound: King, Snohomish, Pierce, and Kitsap counties. While the Washington State Office of Financial Management (OFM) is the official source for population forecasts under the GMA, PSRC is mandated through federal and state guidelines, and its interlocal agreements with member jurisdictions, to maintain demographic forecasting capability, primarily for use in travel demand models.

The PSRC forecasts population to 2030 using regional and local economic and demographic models and land use data. The GMA requires that, at a minimum, each county that plans under the Act accommodate certain 20-year growth projections. The PSRC provides the long-range population and employment sub-area (sub-county) forecasts that support the adopted regional vision as well as the overall goals of the GMA.

The PSRC models are calibrated with forecast analysis zone (FAZ) data for a ten-year period. For example, the 1995 forecasts used the 10-year period between 1980 and 1990. The calibration data sets consisted of population, household, employment, and land use estimates for the years 1980 and 1990. The land use data, in part from local government land use inventories, is summarized by the PSRC as follows[2]:

> "Residential and employment land use is defined as the amount of land in FAZ occupied by residential or various nonresidential used, respectively. Vacant developable land is the amount of land in FAZ that is useable for

[2] PSRC, Population and Employment Forecast Report, August 1995, pp 27-28

development but currently unoccupied by residential, employment, streets, parts or other uses. Other land use (or balance) includes streets, parks and undevelopable land (determined by local policy)[3]".

Summary of Previous PSRC Forecasting

Process and STEP

STEP[4] is the PSRC adopted regional forecasting model. Designed for long-range forecasting and analysis, the econometric model generates projections for economic and demographic variables for the Puget Sound (PS) region (King, Kitsap Pierce and Snohomish Counties) to the year 2030. This model depicts the economic and demographic behavior of an urban region within the context of its state and national economic environment. The model is a simultaneous system of equations specified to forecast over 100 variables with over 100 equations and nearly 30 accounting entities. The parameters of the behavioral equations are estimated with annual data as well as with information from various input-output studies. The model employs over 50 exogenous variables such as US manufacturing production and Washington personal income, which express economic conditions in the nation and the state. The model makes annual economic and demographic forecasts for the PS region; the modelers themselves project some variables such as aerospace production and military employment area.

The STEP adopted the conceptual framework of the economic base theory of regional growth, which distinguishes between the export (basic) and local (non-basic) demand places on the PS economy. The theory postulates, according to the PSRC, that general economic growth is related to growth of the basic sector and an expansion/decline of exports is expected to trigger a responding process in the regional economy that leads to increased/decreased production, jobs and income in the non-basic sector[5].

Population in the PS region is predicted from regional employment by forecasting persons employed, the labor force participation rate and the unemployment rate. Further, the model allows the regional labor supply to adjust through changes in the rate of migration, maintaining equilibrium with the corresponding national levels in the long run.

The following is a summary of PSRC's STEP and Small Area forecasts since 1994[6]:

- STEP 1994 - Produced updated regional forecasts out to 2020.
- Small Area Forecasts 1995 - Used STEP94 as the basis. The PSRC Executive Board approved these forecasts in April 1995 for use in the Vision 2020 Update and the Metropolitan Transportation Plan. The PSRC General Assembly then adopted these plans in May 1995. This forecast represented the last formal approval or adoption by the Executive Board or the General Assembly of a Small Area Forecast.

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[3] PSRC, Population and Employment Forecast Report, August 1995, P.28

[4] According to the PSRC, the Synchronized Translator of Economic Projections (STEP) model is similar in structure to a Philadelphia model built by Glickman in 1977.

[5] PSRC, Regional Economic and Demographic Data Base, Modeling and Forecasting, September 1997

[6] Personal Communication, Mark Simonson, PSRC, January 28, 2003

- Although, the 1995 Small Area Forecast report implies that the forecasts were approved by the Executive Board for use in the reports, the General Assembly of PSRC only formally adopted the reports, not the forecasts, in May 1995.
- STEP 1997 - Produced updated regional forecasts out to 2020, and later, to 2030.
- Small Area Forecasts 1999 - Used STEP97 as the basis. Characterized as a working set of forecasts, they extended again out to 2020.
- Small Area Forecasts 2001 - Updated the 1999 forecasts, although STEP97 results were still being used as the base. Extended the STEP97 results out to 2030, and added updated information on population, households and jobs to estimate a base year 2000 dataset.

At the time the RWSP was adopted in 1999, PSRC forecasted population growth through 2020. King County extended this forecast through 2050 by applying a linear trend function, essentially assuming that growth would continue at the same rate until 2050, the time when the area is expected to reach saturation for wastewater services.

It is important to note that PSRC does not currently plan to resume the process of having its Board or General Assembly approve/adopt forecasts in the future. The current schedule calls for a major update (with a new STEP model forecast) every three to four years, with annual minor updates occurring during the off years.[7]

Table 1. PSRC four county regional 2000 population forecasts compared with Census 2000 population data

Source	Population	% difference to Census 2000
Census 2000	3,275,847	--
STEP 1997	3,340,100	+2%
STEP 1994	3,191,800	-2.6%
STEP 1991	3,245,100	-0.9%
STEP 1986	3,277,000	+0.03%

Small Area Forecasts

Forecasts by sub areas, such as the FAZs, are developed using models and several sets of data and assumptions. The models are the Disaggregated Residential Allocation Model (DRAM) and the Employment Allocation Model (EMPAL) [8].

Forecast Analysis Zones - The PSRC generates its data by allocating regional population and employment forecasts to small geographic areas, or FAZs. FAZ boundaries are derived from census tracts. There are approximately 219 FAZs in the regional study area. The forecasts are then allocated to a finer zone structure or Transportation Analysis Zones (TAZs) for uses in the Council's travel demand models.

[7] Personal Communication, Mark Simonson, PSRC, January 30, 2003

[8] DRAM and EMPAL are registered trademarks of Putman and Associates. The PSRC has used a variation of these urban activity models since 1981. They have been modified to reflect the characteristics of the Puget Sound Region and, according the PSRC in their 1995 report, are not the trademark versions.

These technical steps by the PSRC are only the first step. The preliminary forecasts undergo extensive review by local government elected officials and staffs, other public agencies and others. Comments are received by PSRC staff and after a review finalized working forecasts at the FAZ level are released.

Population Categories – Classification systems group or aggregate producing units into industries. The present U.S. Standard Industrial Classification (SIC) system is hierarchical in that each level of the system provides an aggregation of detail at the next lower level. The SIC system also aggregates the four-digit industries into higher level aggregations, the SIC three- digit and two-digit industry groups. The PSRC data were grouped based on the SIC.

Table 2. PSRC forecasts (using the DRAM and EMPAL models) in 5 industry sectors based on the SIC[9]:

Category	SIC
Manufacturing	SIC 19-39
WTCU: Wholesale trade, Transportation services, Communication, Utilities	SIC 40-42, 44-51
Retail Trade	SIC 52-59
Services	SIC 07,60-67,70-76, 78-81, 83-84, 86,89
Government, Education	SIC 43, 82,92-97

Population data from the PSRC are re-grouped by King County into three categories: residential, commercial and industrial. The residential category is the same as the total population category in the PSRC forecast. The commercial category consists of PSRC's Retail, WTCU, EDU, government and services employment categories. Prior to the RWSP, WTCU was included in the industrial category due to business' type of flow. However, more recent studies by the County, including that of the RWSP are more concerned with volume of flow, in which case WTCU more closely matches the flow volume for retail, FIRES and government rather than to industrial. The industrial category consists of PSRC's manufacturing category.

FAZ and Wastewater Service Basin Overlay

In developing a wastewater flow projection model, the population data had to be converted from FAZ geographic units into wastewater service basin geographic units. Service basins identify the source of flow for major wastewater interceptors; therefore, they are a more logical geographical boundary for modeling wastewater flow than smaller geographic units such as the FAZs. When overlaying the two geographic units for example, the FAZ and service basin boundaries are non-coincidental. This difference created a challenge when proportioning the FAZ population into the service basins because of the uniform inherent distribution assumption of the population within a FAZ.

[9] PSRC, Regional Economic and Demographic Data Base, Modeling and Forecasting, September 1997

Snohomish, King, and Pierce counties were subdivided into service basins that generally reflect hydrologic basins. Exceptions were areas where a pump station may transfer sewer flows from one hydrologic basin to another. With the use of sewer maps, the shapes and sizes of the service basins for King, Snohomish, and Pierce Counties were defined. Service basins were extended to the appropriate adopted County UGA to account for growth. In areas not covered by sewer maps, future service basin boundaries were estimated. Where possible, estimates were based on applicable local and county adopted GMA comprehensive facilities plan; otherwise USGS topographic maps were used.

In King County's earlier RWSP and Brightwater analysis, there were nine major basin divisions for the total regional study area designated as Metro West Side, Kenmore-Snohomish Co., Kenmore King Co., Hollywood P.S., Renton West, Metro East Side, Metro South Side, Snohomish (non-Metro), and Pierce County. These major service basins are depicted in Figure 3. The Metro System includes the West Point Basin and the Renton Basin. The West Point Basin is comprised of Metro West Side, Kenmore-Snohomish Co., Kenmore-King Co. and Hollywood P.S. Basin. Renton Plant Basin is comprised of Metro East Side and Metro South Side. The Total Regional System included the Metro System, Snohomish (non-Metro) and Pierce County.

GMA and the UGA

The RWSP and the Brightwater Draft EIS level work incorporated the King County and Snohomish County UGA constraints in its forecasting and allocation. The boundary of the UGA is the urban growth boundary (UGB), which is non-coincidental with the PSRC FAZ boundaries. Information on allocating population on either side of the UGB within a FAZ is not provided in the PSRC data. Therefore, the rural residential, commercial, and industrial densities per FAZ were estimated for each 10-year increment. The rural density was multiplied by rural acreage and subtracted from total FAZ population to determine the remaining population on the urban side of the UGB. This remaining urban population was used in the model, in the early work, to calculate population per service basin.

Population Assumptions & Methodology

Total population was calculated for residential, commercial, and industrial categories. The assumption was made that 100 percent of the commercial and industrial employment populations contributed to the base sanitary flow, however, only a percentage of the total residential population contributed for the years prior to 2020 in that all residential population is not sewered. The model assumed that for 2020 and beyond, all residential population would be on sewers within the particular Countywide UGA.

For the years preceding 2020, most residential population in the service basins was estimated to be less than 100 percent sewered, particularly those on the eastern edge of the Puget Sound Regional Study area. To estimate the percentage land sewered for 1990, the King County sewered area map was overlaid on the service basin map. The land area sewered within each basin was determined by planimetry and normalized to match PSRC acreages. The actual number of people on sewers per basin was unavailable and was estimated based on the percentage land sewered within each basin in conjunction with aerial maps to identify types

of land development. The percent residential population and employment sewered between 1990 and 2020 was linearly interpolated such that all population and employment was 100 percent sewered by the year 2020. For 2020 and beyond, all residential population and employment was assumed 100 percent sewered.

For Snohomish County, existing maps and knowledge of the region were used to establish percent population sewered. In Pierce County the percent land sewered was based on the service basin "Pacific" located in King County due to similarities between the Pacific basin and Pierce County basins.

RWSP Average Wet Weather Flow (AWWF) Estimates

In general terms, the method used for converting forecasted population and employment data to wastewater flow projections is to multiply population forecasts by factors representing average volumes of wastewater generated per person, yielding a "base" sanitary flow. For example, past studies and measured sanitary flows show that the average residential customer generates approximately 60 gallons of wastewater per day. Commercial and industrial employees generate about 35 and 75 gallons per day, respectively.

The residential flow factor of 60 gallons per capita per day (gpcd) has been used historically by King County and former Metro to develop both the South and West Point systems. The industrial and commercial flow factors of 75 and 35 gallons per employee per day (gped), respectively, were derived based on permitted flow for industrial processes, and on modeling and measured flows at the plants for commercial employees. Using measured flows along with King County's hydraulic model and the assumption that residential flows equal 60 gpcd, the relationship between industrial and commercial flow factors was established.

To determine if the unit flow factors were reasonable, King County compared the base sanitary flow estimates with dry weather flows measured from each treatment plant for 1990. Dry weather flows include base sanitary flow plus dry weather infiltration and inflow (I/I). The estimated flows derived from population and sewered area compared closely with the measured flows.

King County uses average wet weather flow (AWWF) as a summary parameter to evaluate how capacity limits are met at the treatment plants, even though there are several parameters that must be monitored and tracked. In the 1980s, the South Plant expansion was triggered based upon reaching the average wet weather flow parameter. AWWF continues to be one of the design parameters that is used to summarize a range of parameters that track plant capacity.

Current NPDES permits require that King County submit a plan and schedule for maintaining capacity to achieve permit limits when the plant reaches 85 percent of any one of the design criteria for three consecutive months or when the projected capacity increases would reach design capacity within five years, whichever occurs first. The design criteria include average flow for the maximum month, influent BOD loading for the maximum month, or influent TSS loading for the maximum month. King County has already met the threshold at both the South Treatment Plant and West Point. Accordingly, King County submitted the Regional Wastewater Services Plan to comply with this permit condition. The

Washington State Department of Ecology (Ecology) approved this plan and is monitoring its implementation.

King County derives AWWF for the base-planning year of 1990 by measuring flow at the treatment plants over several years and adjusting these flows using rainfall data to reflect an average wet period during historical conditions. This approach is unique to King County but has been approved by the Washington State Department of Ecology. The South Treatment Plant service area collection system is a separated system, and its AWWF definition is the average of all flows during the months of November through April (six months). For the West Point collection system, which has combined systems, the AWWF is defined as the average of all non-storm flows during the months of November through April. The projections for AWWF for the Brightwater basins by decade are provided in Table 3. The sewer basins directed at the Brightwater Plant by decade are shown in Figures 4 through 7.

Table 3. RWSP Brightwater Basin Flow Allocation and RWSP AWWF Projections by Decade – Reflects Basins from the Draft EIS

	1990		2000			2010- BEFORE BRIGHTWATER ON LINE			2010-AFTER BRIGHTWATER ON LINE			2020			2030			2050/Sat.		
	West Pt.	South Pl.	West Pt.	South Pl.	BW	West Pt.	South Pl.	BW	West Pt.	South Pl.	BW	West Pt.	South Pl.	BW	West Pt.	South Pl.	BW	West Pt.	South Pl.	BW
Hollywood - Sno.	0.0			0.0			0.0				0.0			0.0			0.0			0.0
Woodinville East	0.1			0.3			0.5				0.5			0.7			0.8			1.0
Woodinville	0.4			0.5			0.5				0.5			0.6			0.6			0.7
Bear Creek Snoh.	0.0			0.1			0.4				0.4			0.4			0.4			0.4
Bear Creek - King	0.6			0.7			0.9				0.9			1.2			1.3			1.5
North Creek - Sno.	2.4			5.2			8.0				8.0			11.3			12.6			14.8
North Creek - King	0.3			0.5		0.6					0.6			0.7			0.8			0.8
Bothell	1.0		1.3			1.4					1.4			1.5			1.6			1.7
Kenmore Sect. 5	0.4		0.5			0.6					0.6			0.8			0.9			1.0
Inglewood	0.7		0.8			0.8					0.8			0.8			0.8			0.9
Swamp Cr.- Sno.	1.3		2.9			4.7					4.7			6.8	7.7					9.2
Swamp Cr. - King	0.4		0.4			0.4					0.4			0.5			0.5			0.52
Lake Forest - Sno.	0.3		0.5			0.6					0.6			0.8	0.8					1.0
Lake Forest - King	0.8		0.9			0.9					0.9			0.9	1.0					1.0
Lyon - Sno.	0.2		0.3			0.3					0.3			0.4	0.4					0.5
McAleer & Lyon	1.3		1.5			1.6					1.6			1.7	1.7					1.8
Lk Ballinger	2.8		3.2			3.5			3.5			3.8			4.1			4.5		
Sub total Flows (mgd)	**13.0**	**0.0**	**12.2**	**7.3**		**15.4**	**10.3**	**0.0**	**3.5**	**0.0**	**22.2**	**3.8**	**0.0**	**29.0**	**15.7**	**0.0**	**20.4**	**4.5**	**0.0**	**36.9**
Hollywood PS-varies	7.1			9.4			11.4			11.4			7.0	6.0			14.0			16.1
Total Flows (mgd)	**20.1**	**0**	**12**	**17**	**0**	**15**	**22**	**0**	**3**	**11**	**22**	**4**	**7**	**35**	**16**	**0**	**34.4**	**4.5**	**0**	**53**
System Flow Balancing																				
System and Plant flows	115.0	61	119.8	92.4		132.3	105.1		132.3	105.1		144.8	121.2		153.6	129.7		169.5	142.9	
North Creek-varies		0.0	-7.3	7.3		-10.3	10.3		-22.2	0.0		-29.0	0.0		-20.4	0.0		-36.9	0.0	
Hollywood PS - varies							0.0		0.0				-6.0			-14.0			-16.1	
Projected AWWF(mgd)	**115**	**61**	**113**	**100**		**122**	**115**		**110**	**105**	**22**	**116**	**115**	**35**	**133**	**116**	**34**	**132.6**	**127**	**53**
Plant Capacity (mgd)			**133**	**115**		**133**	**115**		**133**	**115**	**36**	**133**	**115**	**36**	**133**	**115**	**36**	**133.0**	**134**	**54**
Plant Upgrades																19 mgd upgrade in 2029 to 134 mgd	18 mgd upgrade in 2030 to 54 mgd			

The Brightwater basin flow (RWSP AWWF) by decade provides the percentage of flow from Snohomish County and King County basins to the Brightwater Treatment Plant as shown in Table 4.

Table 4. Percentage of Flows from Snohomish County and King County to Brightwater Treatment Plant by decade based on the RWSP Brightwater Basin Flow

	2010	2020	2030	2050/Saturation
Snohomish County	63%	56%	38%	49%
King County	37%	44%	62%	51%

Figure 8 shows the historical AWWF and the projected AWWF for the King County system compared to system capacity. One observation from the figure is that the measured flow is well below the projected flow for the years 1987–88, 1992–94, and 2000–01. This is because these years are generally described as drought years in the Puget Sound region. In years when the rainfall has been about normal or above normal (1981–82, 1984, 1986–87, 1997, and 1991), the measured AWWF at the treatment plants is very close to the projected AWWF. This figure also shows that in 2013 the projected AWWF will reach the system capacity of 248 mgd. In terms of the individual treatment plants, the West Point Plant will have some capacity beyond 2010, and the South Treatment Plant may reach capacity before 2010, as shown in Figure 9 and Figure 10.

Figure 10 shows that the measured AWWF at the South Treatment Plant has increased rapidly during the 1990s toward the plant's capacity of 115 mgd in 2010. And apart from a dry year and flow transfers in 2001, the measured flows were on track to reach the plant's capacity even sooner unless additional capacity is added to the system.

RWSP Peak Flow Estimates

The sizing of the conveyance system is based almost solely on being able to transport peak flows. For the County's conveyance system, King County proposed and Ecology accepted the use of a 20-year design storm to handle peak hydraulic flows in the separated system. The conveyance system is usually built to handle this peak flow at full build out unless there is a way to phase the conveyance. Some portions of the treatment plant are amenable to phasing so they are usually built in increments to handle the hydraulic peak as the region grows.

Because wastewater facilities are designed to handle peak sanitary flows, additional factors must be applied to estimate the amount of I/I (groundwater and rainfall) entering the system (peak flow is essentially base flows plus I/I). Accordingly, three I/I factors were applied to basins within the service area to account for average dry weather I/I, average wet weather I/I, and peak I/I.[10] The factors were based on long-term rainfall data and a flow simulation.

In addition, I/I estimates were increased by 7 percent by decade (non-compounded) through 2030 to account for deteriorating pipes, leaky joints from new connections, and other factors that typically increase I/I.

[10] (METRO, et al., 1994)

Peak flows were projected starting with 1990 as the base year using King County's hydrologic and hydraulic routing models. The models use various inputs in addition to base sanitary flow estimates and sewered area estimates, and the model was calibrated for 12 sub-areas making up the entire service area. The model simulates flow, including I/I, during dry weather and storm events. Forty-three years of rainfall data was also run through the model to estimate 20-year peak flow in each sub-basin. Peak 20-year flow is the flow that would be expected once every 20 years, on average, based on 50 or 60 year simulations of current conditions. Future peak flows are projected using population, sewered area, existing I/I responses, and a degradation factor for increases in I/I.

The north service area continues to be a major constriction in the system. Based on model results done in 1998, King County estimated that the Kenmore Interceptor (also known as Lake Line) and upstream storage and flow transfers to Edmonds will reach capacity no later than 2010.

RWSP Results/Conclusions

The RWSP flow projections showed that by 2050, King County would need an additional 74 mgd of wastewater capacity in the service area to meet the needs of population growth in the Puget Sound region.

In addition, the volume of wastewater requiring treatment in the service area will reach the wastewater system's capacity in 2010, at which time the Brightwater Treatment Plant will provide 36 mgd of new capacity. Figure 2 shows the RWSP sewer basin allocation for treatment at the Brightwater Plant. Another capacity increment will be provided with the expansion of the South Treatment Plant in 2029 and, if needed, a further expansion of Brightwater in 2040 to 54 mgd. Flows above 54 mgd AWWF, the ultimate capacity of the Brightwater plant, will be redirected to and treated by other King County secondary treatment plants. It is important to consider the ultimate capacity at build-out when designing wastewater facilities because the lifetime of the facilities can easily go beyond 50 years. Accordingly, King County has forecasted 30- to 50-year flow projections for all of its facilities since the first wastewater comprehensive plan was adopted in 1958.

Solids handling is also a critical factor in determining the timing for new treatment plant facilities. Applying unit-loading factors to the population and employment forecasts develops estimates for solids. Biological oxygen demand and total suspended solids are measured daily so there is regular data to be used to estimate future solids loading. Actual solids volumes that leave the plants as biosolids are also measured and used to "back calculate" in-plant facility needs.

Updated Demographic Forecasts and Wastewater Flow Projections

This section describes the efforts of King County to incorporate recent PSRC forecasts using current (2000) Census data to update all system wastewater flow projections and specifically the Brightwater flow projections. The current effort also uses TAZ-level information to account for existing and future population in the appropriate sewer basins. The updates will ensure that King County's wastewater facilities are properly sized and have sufficient capacity available when needed.

Since the late 1990's, King County compared the previous population forecasts with more recent PSRC forecasts and ultimately found that the newer population forecasts for the Brightwater Service area are within a few percent of the forecasts used in the RWSP. In this analysis, population estimates have been updated based on TAZ data developed by the PSRC in late 2002 and are labeled as TAZ 2003.

King County conducted an extensive flow-monitoring program during the 2000-2001 and 2001-2002 wet seasons as part of its I/I Reduction Program. About 800 meters were installed throughout the system in each of the winters. King County computer models have been updated based on the information collected during those monitoring periods.

For the purposes of this population and flow analysis, it is important to note that the original RSWP service area was subjected to the full demographic analysis; only basins that may be directed to the Brightwater Plant, a subset of the larger area, were analyzed for AWWF and peak flows. The updated Brightwater Service Area basins are shown in Figure 11. These basins are important since the County must retain the flexibility to direct flows to plants and facilities with capacity and to provide for interceptor extensions and facility upgrades and expansions. King County, in this way, accommodates updates to population and employment forecasts, new and/or expanded development, validated I/I flows, existing conditions and capacity of major pipes, changes in public policy regarding growth areas, and changes in local system development.

Summary of Recent PSRC Forecasting

Process and STEP Updates

The following is a summary of recent PSRC's STEP and Small Area forecasts development[11].

- STEP 2001/2002 – PSRC produced new regional forecasts out to 2030, using Census 2000 data for the first time.
- Small Area Forecasts (SAF) 2002 – PSRC used the STEP 01/02 results as the base, and incorporated actual 2000 Census and employment data in the base year 2000 dataset at the FAZ level. These forecasts also are consistent at the county level with the mid-range forecasts of population out to 2025 released by Washington State Office of Financial Management (OFM) in January 2002. The SAF 2002 results are available on the PSRC web site, at the FAZ level and in spreadsheet format, at http://www.psrc.org/datapubs/pubs/forecasts_2002.htm

PSRC does not use OFM population numbers as control totals per se. PSRC prepares a 30-year forecast of key demographic variables such as population, households, and employment independent of the OFM procedure through the use of a regional econometric model called the STEP model. The OFM projections are a key parameter during the preparation of the forecasts and the subsequent review period. Early on, during OFM's forecasting process, there were several meetings involving staff from OFM, PSRC, and key demographic staff from the counties. These sessions included the sharing of information, including all PSRC forecast and draft OFM results for early comment.

[11] Personal Communication, Mark Simonson, PSRC, January 28, 2003

In addition, PSRC compared notes on the processes between OFM and PSRC, and continues to work with these agencies to resolve any differences. The value of PSRC's forecasts for use by the region's jurisdictions is significantly reduced if they are not consistent with OFM's projections. The bottom line is that the results of the PSRC regional forecasts, and the OFM population forecasts for the four counties, turned out to be very consistent when compared to the mid-range forecasts. Both processes use many of the same inputs (Census data, long-range national forecasts from the same company, etc.) although the methodologies differ.[12]

The PSRC models are calibrated with FAZ data for a ten-year period as in previous forecasting efforts. Similar to prior forecasts, the 2002 forecasts used the calibrated model equations developed from the 1980 and 1990 datasets, as to fully recalibrate, the models require the use of the Public Use Microdata Sample (PUMS) data from the 2000 Census, which is currently scheduled for release in December 2003. However, the 2002 forecasts were able to use other Census 2000 data, plus updated employment data, to develop the 2000 base year for the current forecasts. The Buildable Lands Inventory (BLI), developed by each county over the past several years, was used as a cross check by the PSRC and the local jurisdictions during their review of the FAZ level forecast.[13] The land use data, in part from local government land use inventories, is summarized by the PSRC in 1995 as follows:

> "Residential and employment land use is defined as the amount of land in FAZ occupied by residential or various nonresidential used, respectively. Vacant developable land is the amount of land in FAZ that is useable for development but currently unoccupied by residential, employment, streets, parks or other uses. Other land use (or balance) includes streets, parks and undevelopable land (determined by local policy)"[14].

Small Area Forecasts

PSRC provides small area forecasts updates based on Census 2000 data. PSRC has recently described the employment-forecast process as based on four hierarchical databases:

- Geocoded Points: Result of point-level data work using ES-202 data from Washington State Employment Security Department (ESD)
- Covered Employment: Result of applying factors to geocoded points to match totals published by ESD
- Total Employment: Result of applying factors to estimate the amount of jobs in the region not captured by ESD's reporting requirements. These factors apply to the national level and therefore, generally are not used.
- Modeling Employment: Result of specific adjustments for input to DRAM, EMPAL and ultimately to Travel Demand models. These adjustments include, but are not limited to, dropping the Resource/Construction jobs, adding military personnel assigned to ships, switching UW from the Education to Government category, switching Puget Sound Naval Shipyard jobs from Government to Manufacturing.[15]

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[12] Personal Communication, Mark Simonson, PSRC, January 30, 2003
[13] Personal Communication, Mark Simonson, PSRC, August 4, 2003
[14] PSRC, Population and Employment Forecast Report, August 1995, P.28
[15] Personal Communication, Mark Simonson, PSRC, May 30, 2003

Figure 12 gives a visual representation of the PSRC employment forecast process described above.

Forecast Analysis Zones

FAZ boundaries were adjusted in the 2002 Small Area Forecasts to match changes that occurred in Census geography in the 2000 Census. This impacted primarily rural-area FAZs where Census tracts were adjusted to actually follow a physical attribute; the 1990 Census tracts were allowed to follow arbitrary lines on a map. The total number of FAZs is the same as previous at 219, and the numbering of individual FAZs has not changed.

Traffic Analysis Zones

TAZs are Traffic Analysis Zones, which are smaller in extent than Forecast Analysis Zones (FAZs). PSRC initially forecasts population and employment by FAZ. After review and comment by local jurisdictions, the FAZ forecasts are revised and published. PSRC then develops forecasts for TAZs, which provides greater specificity on where population is currently and where it is expected to grow. King County Wastewater Treatment Division (KCWTD) now uses the TAZ information to account for existing and future population in the appropriate sewer basins; prior to 2003, FAZ level information provided the basis for its wastewater flow projections.

As mentioned before in the Small Area Forecasts section, FAZ level information goes through extensive review by local government elected officials and staffs, other public agencies and finally PSRC before it is released. Therefore as TAZ information is generated from FAZ level information, the TAZ forecasts also reflect information that has undergone local review.

TAZ boundaries were modified to match 2000 Census changes. This resulted in an increase in TAZs from 832 to 938. The numbering of the TAZs also changed, so that what was TAZ 200 in the 1991 zone system (832 zones) might now be TAZ 400 in the new 2000 (938 zone) system. While the 2002 Small Area Forecasts have been divided according to the TAZ 2000 system, they have not yet been officially used to build PSRC travel forecasts. The target date for implementing the new Travel Demand model is July 2003.[16]

Maps for all the zone systems, including both Adobe Acrobat and ArcView shapefile formats, can be obtained from the PSRC web site, at http://www.psrc.org/datapubs/maps/index.htm.

Updated Population Forecasts

Updated population forecasts provided by the PSRC are based on 2000 Census data. Growth trends for residential, commercial, and industrial population categories to 2030 were analyzed for five regions of the King County Wastewater Service Area. The five regions are Brightwater, West, Renton East, Renton South, and Renton West and are depicted in Figure 1. For the purposes of this analysis, the Brightwater region here includes all basins so defined in the RWSP as possibly contributing to the Brightwater treatment plant.

The updated population forecasts within the King County wastewater service area closely agree with previous PSRC modeling for residential and commercial growth within the same area. The forecasts indicate that residential and commercial growth will increase in all five regions.

[16] Personal Communication, Mark Simonson, PSRC, May 30, 2003

Conversely, industrial employment forecasts show decreased growth in four of the five regions analyzed within the King County wastewater service area through 2030.

Population Forecast Comparison

King County analyzed differences between PSRC's FAZ 1995 and TAZ 2003 forecasts within its wastewater service area[17]. Figures 13 through 15 contain graphs, which compare FAZ 1995 data with TAZ 2003 data across the three categories of population: residential, commercial, and industrial for each of the regions noted above. Special emphasis is placed on the population forecast changes for population within the Brightwater service area.

The population forecast analysis shows that for the Brightwater service area, current residential population forecasts are essentially the same as previous forecasts. Current commercial employment forecasts are higher than before and current industrial employment forecasts are lower than previous forecasts within the Brightwater service area.

The differences in PSRC commercial employment forecasts for the Brightwater service area suggest that the original commercial population was significantly underestimated and that commercial growth is higher than expected. The greatest percent difference is approximately 20 percent in 2020. The industrial employment forecasts show a decreasing trend within the Brightwater service area with the percent difference in forecasts at approximately 5 percent in 2020.

Updated Population Analysis Methodology

The following are updated population methods/assumptions used by King County for determining sewered populations within its service area:

- Commercial and industrial employment from any TAZ crossing the UGB are considered sewered and within the UGA.
- Total population within a TAZ and crossing the UGB and basin boundaries is distributed according to the location of non-vacant parcels.
- Sewered residential, commercial, and industrial populations are distributed according to sewered, non-vacant parcels.
- Parcels that are sewerable and currently vacant and/or non-sewered in 2000 within the King County service area are assumed to be half occupied and sewered by 2010 and completely occupied and sewered by 2020.
- Multi-unit parcels with greater than four units are assumed to be sewered. Multi-unit parcels with less than four units are assumed to be sewered based on the sewer and GIS coverage developed for the King County Regional I/I Reduction Program (I/I project).
- Any parcel not containing residential, commercial or industrial populations such as ball-fields, cemeteries, rights-of-way, and water-bodies were not included in determining the distribution of the populations.
- Geography was based on 2003 PSRC TAZ boundaries, 2003 PSRC forecasts, RWSP basin boundaries (updated to reflect connectivity and flow identified in the I/I project),

[17] King County WTD labels the PSRC 2002 forecasts as TAZ 2003 as these were released by PSRC in early 2003.

March 2003 King County and Snohomish County parcel geography and present use and 2001-2002 season Sewer land developed for the I/I project.

- Additional geographic analysis was conducted using King County's sewer agency GIS coverage and the 2001-2002 model basin coverage developed for the I/I project.
- The Microsoft Campus and Boeing's Renton Plant were redistributed within the TAZ post analysis according to concentrated commercial and industrial populations for which the above methodology could not account. This affected 25,000 and 8,000 people respectively.

Table 5. Comparison of Population and Employment Forecasts

Decade	Sewered population: 1998 King County projections	Sewered population: 2002 PSRC FAZ for King County's service area
1990	2,053,746	1,981,643
2000	2,385,578	2,380,283
2010	2,756,598	2,688,001
2020	3,129,189	3,179,354
2030	3,438,937	3,354,826
Percent change 1990 – 2030	67	69

Note: With sewered populations considered

Table 5 above shows that King County's RWSP 1998 projections of sewered population grows by 67 percent from 1990 to 2030 compared to 69 percent for the same period using the 2002 PSRC data adjusted for sewered population in the King County service area. The difference in overall change between forecasts over the 40-year period is insignificant with respect to the County's flow projections.

King County's wastewater flow projection process is described in a flowchart depicted in Figure 16.

Average Wet Weather Flow (AWWF)

The "Average Wet Weather Flow" (AWWF) refers to an average flow during the wet season, November through April. AWWF is the basis for determining nominal capacity in King County's treatment plants. The calculation process is described in the flow diagram depicted in Figure 17.Brightwater Average Wet Weather Flow Projection

Updated AWWF

When King County developed the Regional Wastewater Services Plan, alternative unit flow factors were examined by modeling wastewater unit flow factor changes as a result of water conservation, pricing, and the plumbing and building codes. The County's analysis of the varying flow factors indicated that the base sanitary flows could decrease from 10 to 18 percent using a moderate to aggressive water conservation program. While this sounds significant, it is important to understand that base flow is not a major factor in the timing and sizing of a treatment plant or of its associated conveyance system. Base flow represents less than 20 percent of the peak 20-year storm flow, which is King County's design standard. The potential

conservation measures resulted in peak flow reductions in 2020 from 2 to 4 percent. Peak flows at 2030 are projected to be 608 mgd in the separated portion of the system. This will not change the timing or size of any facilities currently planned. Based on this analysis, and the fact that water conservation benefits are uncertain because they are not mandatory, the flow factors were not adjusted to include reliance on future water conservation beyond the changes described below.

The wastewater factors that were used in the RWSP were reviewed with recent winter water consumption data. The overall residential factor is still a good estimate of wastewater generated by residential population. The commercial factor may be slightly lower than that used in the RWSP. There is strong evidence that the industrial process water consumption has significantly been reduced in the last 10 years.

The City of Seattle has indicated that winter water consumption in Seattle is about 56 gpcd for residential customers. Other water purveyors' in the King County service area show residential winter water consumption is about 66 gallons per capita per day (gpcd). Actual flow discharged from industrial customers in 2001 is about 22 gallons per employee per day (gped). This number should be added to the commercial flow factor to obtain the total industrial flow factor.

The City of Seattle's survey indicated that the combined industrial and commercial flow factor is 36 gped for the city and 31–35 gped for Seattle's wholesale water purveyors. With the inclusion of five other large water purveyors in the King County service area, the combined flow factors is 34 to 37 gped.

It is estimated for year 2000 that about 33 gped was from commercial employees and about 55 mgd was from industrial employees, including process flow.

The change in flow factors using the different residential flow factors for Seattle (56) and other jurisdictions (66 gpcd) resulted in roughly a 4 mgd reduction in average wet weather flow (AWWF) at the West Point Plant and about a 1 mgd increase in AWWF at the South Plant for year 2000.

Thus, it appears that water conservation is being realized faster in the City of Seattle than in other cities of the region and that summer water conservation has been more dramatic than winter water conservation. Winter water conservation affects the wastewater flow more than does summer conservation. However, future reductions in winter water use are uncertain.

AWWF values were updated according to TAZ 2003 population forecasts and new (2003) flow factors as shown in Table 6 below.

Table 6. Updated flow factors (2000) compared with 1995 flow factors

Population Category	1995 Flow factor	2000 Flow factor
Residential Seattle	60 gpcd	56 gpcd
Residential non-Seattle		66 gpcd
Commercial	35 gped	33 gped
Industrial	75 gped	55 gped

The new AWWF estimates for the Brightwater service area basins reflecting updated flow factors and forecasts are summarized and compared with previous estimates in Table 7. Table 8 describes the adopted RWSP Strategy with Updated AWWF Projections by decade using basins as directed in the Draft EIS. The sewer basins directed to Brightwater by decade are identified in Figures 4 through 7. These figures are the same figures referenced earlier in the RWSP AWWF Estimates section as the configuration remains the same.

Table 7. Comparison of previous RWSP AWWF Projections with Updated AWWF Projections for the Brightwater Service Area

	2000		2010		2020		2030		Sat.	
RWSP Basins	RWSP Forecasts (mgd)	2003 TAZ Forecasts (mgd)	RWSP Forecasts (mgd)	2003 TAZ Forecasts (mgd)	RWSP Forecasts (mgd)	2003 TAZ Forecasts (mgd)	RWSP Forecasts (mgd)	2003 TAZ Forecasts (mgd)	RWSP Forecasts (mgd)	2003 TAZ Forecasts (mgd)
Hollywood - Sno.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Woodinville East	0.3	0.3	0.5	0.4	0.7	0.5	0.8	0.5	1.0	0.6
Woodinville	0.5	0.9	0.5	1.0	0.6	1.1	0.6	1.2	0.7	1.3
Bear Creek Snoh.	0.1	0.1	0.4	0.2	0.4	0.3	0.4	0.3	0.4	0.3
Bear Creek - King	0.7	0.6	0.9	0.8	1.2	1.0	1.3	1.1	1.5	1.1
North Creek - Sno.	5.2	5.0	8.0	7.5	11.3	10.8	12.6	12.3	14.8	14.7
North Creek - King	0.5	0.7	0.6	0.8	0.7	0.9	0.8	1.0	0.8	1.0
Bothell	1.3	1.2	1.4	1.4	1.5	1.6	1.6	1.7	1.7	1.9
Kenmore Sect. 5	0.5	0.4	0.6	0.6	0.8	0.7	0.9	0.8	1.0	0.8
Inglewood	0.8	0.8	0.8	0.8	0.8	0.9	0.8	1.0	0.9	1.0
Swamp Cr.- Sno.	2.9	3.6	4.7	5.6	6.8	8.0	7.7	9.2	9.2	11.2
Swamp Cr. - King	0.4	0.5	0.4	0.5	0.5	0.6	0.5	0.6	0.52	0.7
Lake Forest - Sno.	0.5	0.3	0.6	0.5	0.8	0.7	0.8	0.8	1.0	0.9
Lake Forest - King	0.9	0.8	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0
Lyon - Sno.	0.3	0.4	0.3	0.4	0.4	0.5	0.4	0.5	0.5	0.6
McAleer & Lyon	1.5	1.4	1.6	1.5	1.7	1.7	1.7	1.8	1.8	1.9
Lk Ballinger - Sno + King	3.2	3.4	3.5	3.7	3.8	4.0	4.1	4.3	4.5	4.7
Hollywood PS	9.4	8.9	11.4	10.7	13	13.3	14.0	14.0	16.1	15.8
AWWF Totals (mgd)	**28.8**	**29.3**	**37.1**	**37.2**	**45.8**	**47.6**	**50.1**	**52.0**	**57.5**	**59.5**

Table 8. Adopted RWSP Strategy Reflecting Updated AWWF Projections for the Brightwater Service Area – Reflects Basins from the Draft EIS

	1990		2000			2010- BEFORE BRIGHTWATER ON LINE			2010-AFTER BRIGHTWATER ON LINE			2020			2030			2050/Sat.		
	West Pt.	South Pl.	West Pt.	South Pl.	BW	West Pt.	South Pl.	BW	West Pt.	South Pl.	BW	West Pt.	South Pl.	BW	West Pt.	South Pl.	BW	West Pt.	South Pl.	BW
Woodinville East	0.1			0.3			0.4				0.4			0.5			0.5			0.6
Woodinville	0.4			0.9			1.0				1.0			1.1			1.2			1.3
Cross Valley	0.0			0.1			0.2				0.2			0.3			0.3			0.3
Bear Creek - King	0.6			0.6			0.8				0.8			1.0			1.1			1.1
North Creek - Sno.	2.4			5.0			7.5				7.5			10.8			12.3			14.7
North Creek - King	0.3			0.7		0.8					0.8			0.9			1.0			1.0
Bothell	1.0		1.2			1.4					1.4			1.6			1.7			1.9
Kenmore Sect. 5	0.4		0.4			0.6					0.6			0.7			0.8			0.8
Inglewood	0.7		0.8			0.8					0.8			0.9			1.0			1.0
Swamp Cr.- Sno.	1.3		3.6			5.6					5.6			8.0	9.2					11.2
Swamp Cr. - King	0.4		0.5			0.5					0.5			0.6			0.6			0.7
Lake Forest - Sno.	0.3		0.3			0.5					0.5			0.7	0.8					0.9
Lake Forest - King	0.8		0.8			0.9					0.9			0.9	1.0					1.0
Lyon - Sno.	0.2		0.4			0.4					0.4			0.5	0.5					0.6
McAleer & Lyon	1.3		1.4			1.5					1.5			1.7	1.8					1.9
Lk Ballinger - Sno.	2.8		2.8			3.0			3.0			3.3			3.6			4.0		
Lk Ballinger - King			0.6			0.7			0.7			0.7			0.7			0.7		
Streams			5																	
Sub total AWWF (mgd)	**13.0**	**0.0**	**17.9**	**7.7**	**0.0**	**16.6**	**9.9**	**0.0**	**3.6**	**0.0**	**22.8**	**4.0**	**0.0**	**30.3**	**17.6**	**0.0**	**20.5**	**4.7**	**0.0**	**39.0**
Hollywood PS-varies	7.1			8.9			10.7			10.7			7.3	6.0			14.0			15.8
Total AWWF (mgd)	**20.0**	**0.0**	**17.9**	**16.6**	**0.0**	**16.6**	**20.6**	**0.0**	**3.6**	**10.7**	**22.8**	**4.0**	**7.3**	**36.3**	**17.6**	**0.0**	**34.5**	**4.7**	**0.0**	**54.8**
System Flow Balancing																				
West Side	115.0		83.4			86.9			86.9			91.2			95.8			103.6		
East & South		61		85.5			101.6			101.6			121.6			130.8			143.8	
North Creek-varies		0.0		7.7			9.9													
Projected AWWF(mgd)	**115**	**61**	**101**	**110**		**104**	**132**		**91**	**112**	**23**	**95**	**129**	**36**	**113**	**131**	**34**	**108**	**144**	**55**
Plant Capacity (mgd)			**133**	**115**		**133**	**115**		**133**	**115**	**36**	**133**	**115**	**36**	**133**	**134**	**36**	**133**	**145**	**54**
Plant Upgrades													**19 mgd upgrade in 2012 to 134 mgd**			**9 mgd upgrade in 2029 to 145 mgd**	**18 mgd upgrade 2030-2050 to 54 mgd**			

The RWSP Brightwater basin flow (updated AWWF) by decade provides the percentage of flow from Snohomish County and King County basins to the Brightwater Treatment Plant as shown in Table 9 below.

Table 9. Percentage of Flows from Snohomish County and King County basins to the Brightwater Treatment Plant by decade based on the RWSP Brightwater Basin Flow and updated AWWF numbers

	2010	2020	2030	2050/Saturation
Snohomish County	62%	72%	77%	79%
King County	38%	28%	23%	21%

The implications of the updated AWWF data are that the South Plant may reach its 115 mgd capacity earlier than originally projected and that Lake Forest Park and McAleer/Lyon basin flows can be diverted to West Point through 2050. King County will be carefully monitoring population and flow by basin and conducting further analysis of changes occurring in the South King County area, including evaluation of I/I reduction and water conservation.

Figure 11 shows the current updated sewer basin allocation for treatment at the Brightwater Plant.

Updated Peak Flow Estimates

Updated peak flow estimates are based on three main areas of change: new sewered population methodology, new flow meter data, and a different I/I model. The methodology for determining peak flow estimates is described in the flow diagram depicted in Figure 18.

New flow data from King County's Inflow & Infiltration Program have also been incorporated into updated preliminary peak flow estimates. The data was collected during the 2000-2001 and 2001-2002 wet seasons. For the Brightwater service area, King County's extensive monitoring program translated flow data from 40 meters compared to 7 available meters used for RWSP peak flow estimates. And a new updated flow projection model (MOUSE) was utilized rather than the KC I/I model to develop flow characteristics.

Preliminary 2000 Conditions based on updated peak flow estimates

- Updated peak flow estimates show that peak 20-year flows in the Brightwater service area in 2000 are only 4 percent higher overall than previously estimated.
- Some basin flows to Kenmore Lake Line are higher than anticipated for 2000.
- Capacity in conveyance leading to existing County treatment plants may be exceeded earlier than anticipated. The Brightwater system is expected to alleviate predicted increased overflow probabilities in the north end of Lake Washington if it is online in 2010.

This preliminary finding is supported by recent checks against the model, comparing our 1998 modeled flows for basins discharging to the Lake Line for the year 2000 against updated peak flows modeled using actual rainfall data from the 2001–2002 wet season. The results shown in the table below confirm that original estimates of peak flow from the northern part of the King County Service Area are still valid with specific basin variations noted.

Table 10. Comparison of Previous and Current Peak Flow Estimates to the Kenmore Interceptor

Basin	Original Year 2000 20-year Peak (mgd)[a]	Updated Year 2000 20-year Peak (mgd)[b]
Swamp Creek – Snohomish County	9.6	7.1
Swamp Creek – King County	1.7	1.7
Kenmore Section 5 plus Bothell	5.8	8.8
Inglewood	2.6	3.6
Lake Forest Park – Snohomish & King Co.	5.4	5.4
Lyon Creek – Snohomish Co.	0.7	1.7
McAleer & Lyon	6.2	6.2
Lake Ballinger Pump Station	16	14
Total	48	48.5

a Modeled flow in 1998

[b] Modeled flow using measured rainfall from the 2001–2002 wet season

Preliminary 2050 Conditions based on updated peak flow estimates:

- Updated peak flow estimates range from 156 to 190 mgd depending on new construction I/I assumptions. Therefore, the design peak 20-year flow estimate of 170 mgd in the RWSP is still valid for the Brightwater Plant at Saturation (2050).
- Depending upon the sub-regional flow management plan, flows from the northern part of the Sammamish Plateau could add 5 mgd total to the Brightwater system rather than to the South Plant system.

Updated Results/Conclusions

In late 1999, the King County Council adopted a regional plan to build a new treatment plant in the north end by 2010. This decision occurred after several years of lengthy debate over whether to maximize the existing two-plant system by expanding West Point and the South Plant in 2010. An environmental impact statement was prepared and the consequences of delaying new capacity or downsizing King County's facilities based on periodic fluctuations in projections or inadequate temporary facilities are unacceptable for public health, the environment, and the economy.

Analysis of the updated PSRC data suggests that the previous population and employment forecasts within the King County wastewater service area are similar to current (2000) population and employment forecasts for residential and industrial categories. Significant residential growth is expected particularly in the Brightwater service area, while industrial growth is expected to decline in four of five analyzed regions in the King County wastewater service area. For the purposes of the population and employment analysis, the Brightwater service area includes all basins so defined in the RWSP as potentially sending flows to the new plant.

All indicators used to project conveyance and treatment plant capacity indicate that King County is running out of capacity.

Capacity will be exceeded in the north end conveyance and storage no later than 2010.

Capacity at the South Plant is estimated to reach capacity around 2010, which is sooner than originally expected.

West Point solids handling is already at or near its capacity.

The County will monitor this carefully to see if the trend continues and will consider modifications to the plant to ensure that the County is able to meet its effluent limits until the Brightwater Treatment Plant is online.

Flexibility

Although the population forecasts and flow estimates remain similar to those done in 1998, in order to carry out its mandate to protect public health in this region, King County must maintain its ability to direct flows to plants and facilities with capacity and to make necessary interceptor extensions and improvements and other facility upgrades and expansions as necessary. This flexibility enables King County to maximize the use of existing capacity, divert flows for maintenance purposes, and prevent overflows during storm conditions. By incorporating updates to population and employment forecasts, considering new and/or expanded development, validating I/I flows, assessing current condition and capacity of major pipes, incorporating changes in public policy regarding growth areas, and integrating local system improvements and changes into the system wide flow management plan, the county will be able to meet its contractual obligations with each component agency as well as any water quality requirement and related regional public health and safety responsibility. As conditions change, service areas for each of the regional plants may be adjusted to maintain service system wide. Upgrades and expansions of treatment plants or interceptors may be built sooner or later.

King County will monitor flow projections and may need to move flows from one basin to another to maximize capacity available at West Pt. and/or expand South Plant earlier than anticipated. Table 11 describes an example of varying the redirection of various Brightwater basins to optimize the management of flow with plant capacity. The corresponding maps (Figures 19-22) depict this possible future basin redirection through the year 2050 (saturation) based on this flexibility. These kinds of variations must be balanced with the entire system over time.

Table 11. RWSP Brightwater Basin Flow Alternative Allocation and RWSP AWWF Projections by Decade

	1990		2000			2010- BEFORE BRIGHTWATER ON LINE			2010-AFTER BRIGHTWATER ON LINE			2020			2030			2050/Sat.		
	West Pt.	South Pl.	West Pt.	South Pl.	BW	West Pt.	South Pl.	BW	West Pt.	South Pl.	BW	West Pt.	South Pl.	BW	West Pt.	South Pl.	BW	West Pt.	South Pl.	BW
Hollywood - Sno.	0.0			0.0			0.0				0.0			0.0			0.0			0.0
Woodinville East	0.1			0.3			0.5				0.5			0.7			0.8			1.0
Woodinville	0.4			0.5			0.5				0.5			0.6			0.6			0.7
Bear Creek Snoh.	0.0			0.1			0.4				0.4			0.4			0.4			0.4
Bear Creek - King	0.6			0.7			0.9				0.9			1.2			1.3			1.5
North Creek - Sno.	2.4			5.2			8.0				8.0			11.3			12.6			14.8
North Creek - King	0.3			0.5		0.6					0.6			0.7			0.8			0.8
Bothell	1.0		1.3			1.4					1.4			1.5			1.6			1.7
Kenmore Sect. 5	0.4		0.5			0.6					0.6			0.8			0.9			1.0
Inglewood	0.7		0.8			0.8					0.8			0.8			0.8			0.9
Swamp Cr.- Sno.	1.3		2.9			4.7					4.7			6.8	7.7					9.2
Swamp Cr. - King	0.4		0.4			0.4					0.4			0.5			0.5			0.52
Lake Forest - Sno.	0.3		0.5			0.6			0.6			0.8			0.8					1.0
Lake Forest - King	0.8		0.9			0.9			0.9			0.9			1.0					1.0
Lyon - Sno.	0.2		0.3			0.3			0.3			0.4			0.4					0.5
McAleer & Lyon	1.3		1.5			1.6			1.6			1.7			1.7					1.8
Lk Ballinger	2.8		3.2			3.5			3.5			3.8			4.1			4.5		0.0
Subtotal Flows (mgd)	**13.0**	**0.0**	**12.2**	**7.3**	**0.0**	**15.4**	**10.3**	**0.0**	**6.8**	**0.0**	**18.9**	**7.5**	**0.0**	**25.3**	**15.7**	**0.0**	**20.4**	**4.5**	**0.0**	**36.9**
Hollywood PS - varies	7.1			9.4			11.4			11.4			7.0	6.0			14.0			16.1
Total Flows (mgd)	**20.0**	**0.0**	**12.2**	**16.7**	**0.0**	**15.4**	**21.7**	**0.0**	**6.8**	**11.4**	**18.9**	**7.5**	**7.0**	**31.3**	**15.7**	**0.0**	**34.4**	**4.5**	**0.0**	**53.0**
System Flow Balancing																				
System and Plant flows	115.0	61	119.8	92.4		132.3	105.1		132.3	105.1		144.8	121.2		153.6	129.7		169.5	142.9	
North Creek-varies		0.0	-7.3	7.3		-10.3	10.3		-18.9	0.0		-25.3	0.0		-20.4	0.0		-36.9	0.0	
Hollywood PS - varies							0.0		0.0				-6.0			-14.0			-16.1	
Projected AWWF(mgd)	**115**	**61**	**113**	**100**		**122**	**115**		**113**	**105**	**19**	**120**	**115**	**31**	**133**	**116**	**34**	**132.6**	**127**	**53**
Plant Capacity			**133**	**115**		**133**	**115**		**133**	**115**	**36**	**133**	**115**	**36**	**133**	**115**	**36**	**133**	**134**	**54**
Plant Upgrades:																19 mgd upgrade in 2029 to 134 mgd	18 mgd upgrade 2030-2050 to 54 mgd			

The alternative example Brightwater basin flow (RWSP, AWWF) by decade provides percentages of flow from Snohomish County and King County basins to the Brightwater treatment plant as shown in Table 12.

Table 12. Percentage of flows from Snohomish County and King County basins to the Brightwater treatment plant by decade based on redirected RWSP Brightwater basin flow (RWSP AWWF)

	2010	2020	2030	2050/Saturation
Snohomish County	69%	59%	38%	49%
King County	31%	41%	62%	51%

Issues

Septic System Conversion

An estimated 104,000 people are on septic systems in the King County Sewer Service Area. This represents a potential 8 mgd of average wet weather flow that King County will be required to treat if and when they hook up to the sewer system. For the RWSP it was assumed that King County would need to provide sewer treatment for these households by 2020. This 8 mgd of AWWF represents about three years of growth in wastewater flow.

If these septic system households do not hook up to the sewer system by 2020, King County can accommodate more growth in the region prior to expanding existing treatment plants. However, it does not significantly affect the timing for Brightwater, since that timing is driven by peak flows in the north part of the King County service area. Only plant upgrades after Brightwater would be affected. By then, we will have another decade of septic system conversion data on which to refine future assumptions. Since the septic systems are widely distributed, the rate of conversion is less likely to affect the timing of major expansions to the system. However, the rate of conversion may affect the timing of interceptor extensions in areas where there may be a concentration of septic systems that have not yet converted.

In the RWSP, it was assumed that 118,000 people were on septic systems in the King County sewer service area in 1990. It was estimated that 101,000 people would be on septic systems in 2000. Recent information suggests that about 104,000 people, or about 40,000 homes, were on septic systems in 2000. Therefore the septic population assumption and estimate in the RWSP is in close agreement with recent information.

For the RWSP, KC is used an estimated date of 2020 as a target of when these people will all be on sewers. It is not expected that 100 percent of the people will be converted from septic systems to sewers by 2020. That is merely a target date by which King County may need to accommodate increased flows from such conversions if they do take place.

The estimate of 104,000 people represents a potential 6.2-mgd of base sewage flow and about 8 mgd of average wet weather flow (AWWF). So out of King County's total projected AWWF of 237 mgd in 2010, about 4 mgd is due to the assumption that 20,000 homes will convert from septic systems to sewers between 2000 and 2010. If the homes do not convert to sewer, then the King County system will have that additional capacity (up to 4 mgd) to either accommodate faster growth in the region or to possibly delay treatment plant upgrades. However, the main

driving issue for the need for treatment capacity in 2010 is peak flow conveyance restrictions in the north end of the King County service area. The impact of the septic systems not converting to sewer would have a very small impact on the peak flow issues King County is addressing by 2010.

To put this potential 8-mgd of potential AWWF flow in perspective, the AWWF flow to King County system is projected to grow at 2.5 mgd per year between 2000 and 2010. So if only 1/3 of the 20,000 households converted to sewer between 2000 and 2010, the 2.7-mgd of AWWF that those that don't hook up represent would offset about 1 year of growth due to population increases that are expected. And if none of the septic system households ever hooked up to the sewer, it would impact treatment plant schedules after 2020 by only 3 years.

New estimates of septic system households and population will be updated at least every 10 years (along with the census data) to ensure that King County is not overbuilding or building sooner than is necessary.

Since the assumption of when septic system households will hook up to the King County sewer system only affects the on-line date of treatment facilities by 1-3 years, and only affects those treatment plant upgrades after Brightwater is on-line in 2010, it is recommended that the current assumptions be used for current planning purposes and refined for subsequent planning studies.

Edmonds/King County Transfer

The City of Edmonds and King County have an interlocal agreement to transfer wastewater flows between systems. Woodway and portions of the Shoreline area (served by the Ronald Wastewater District) are pumped through King County's Richmond Beach Pump Station and force main to Edmonds, and Edmonds treats it for King County. Figure 23 depicts the Edmonds/King County flow transfer. Flows from King County's Richmond Beach Pump Station to Edmonds runs about 2-mgd on average. The maximum pumping capacity at the County's Richmond Beach Pump Station is 10.7 mgd. In exchange, King County pumps a portion of the flow from the Lake Ballinger Pump Station into the McAleer trunk and on to West Point for treatment. The Lake Ballinger Pump Station owned and operated by King County, pumps flows received from areas of Edmonds, Mountlake Terrace, Olympic View Water and Sewer District and the Ronald Wastewater District. The station has a capacity to pump up to 6-mgd to Edmonds and 9.8-mgd to West Point; generally it pumps about 2-3 mgd on average.

During the wet half of the year, all flows from the Lake Ballinger Pump Station are pumped to Edmonds. However, during extreme storms, flows that exceed the station's 6-mgd capacity to pump to Edmonds are sent to West Point for treatment. During the dry half of the year, the station sends a portion of its flow to West Point, to match the amount of flow the Edmonds Treatment Plant receives from the Richmond Beach Pump Station. Typically, the balance of the flow pumped at the Lake Ballinger Pump Station, approximately 1-mgd, is pumped to Edmonds regardless of time of year.

At present, King County treats about 2 mgd of Lake Ballinger PS flow at either Brightwater or West Point during dry weather periods. In 2012, King County will treat it all year according to this agreement. The underlying financial intent of the agreement is that King County and Edmonds would each be treating the same volume of flow so the agreement is revenue/cost

neutral when equivalent flows are treated. However, during the time when Edmonds is treating the King County share for six months, King County will pay Edmonds a fee based on volume. Similarly, Edmonds pays King County a fee based on volume for flows that come through the Lake Ballinger Pump Station. Flows from Richmond Beach will continue to go to Edmonds.

The City of Edmonds has an interlocal agreement with Mountlake Terrace, Olympic View Water and Sewer District and the Ronald Wastewater District that provides these agencies a contractual right to capacity at the Edmonds treatment plant. These agencies paid for the construction of the plant through their own financing. Annual treatment plant operations and maintenance costs, as well as capital expenses, are shared between the participants proportionate to the capacity purchased.

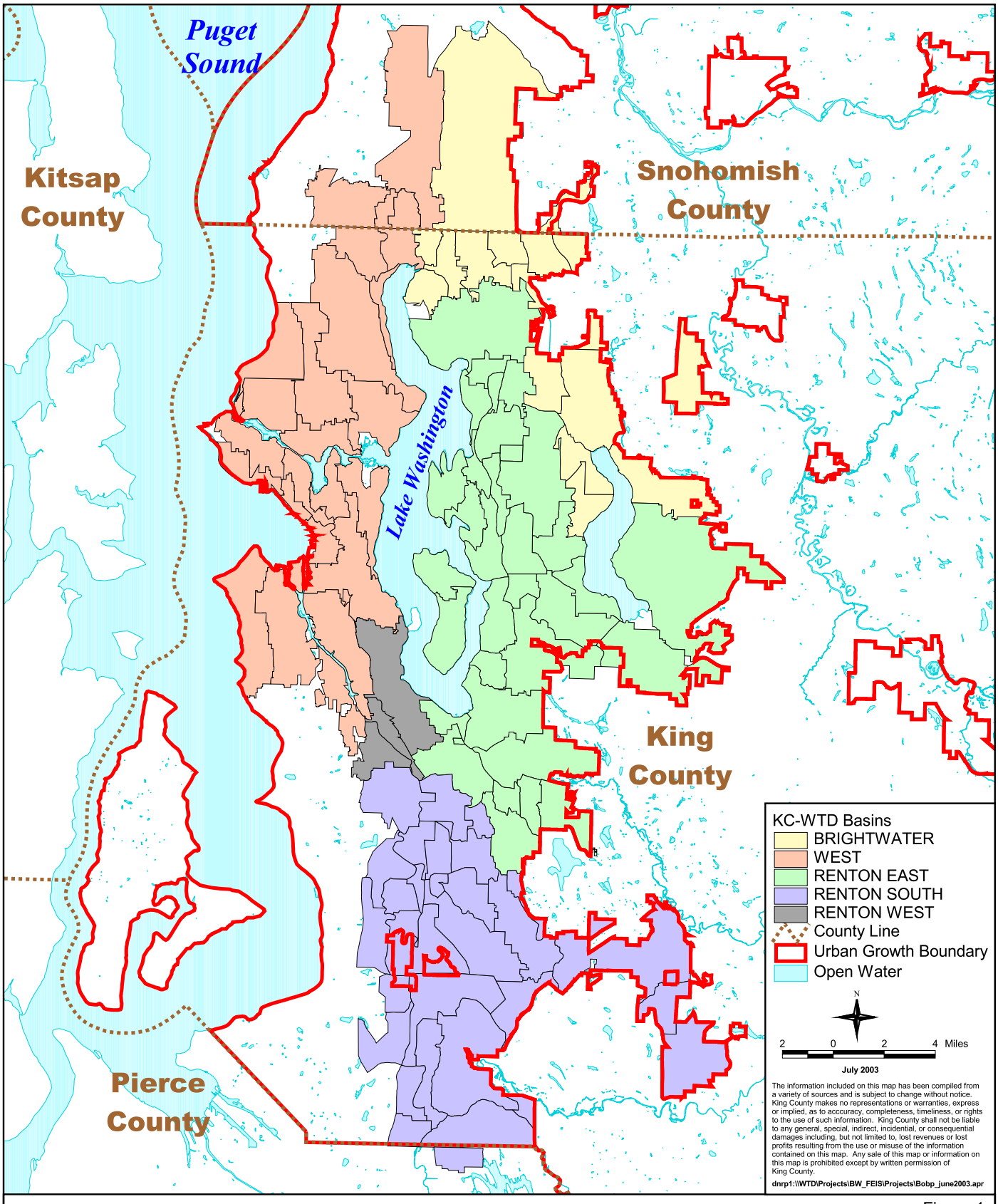

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Figure 1

Five Regions Analyzed for Population and Employment of the King County Wastewater Service Area

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

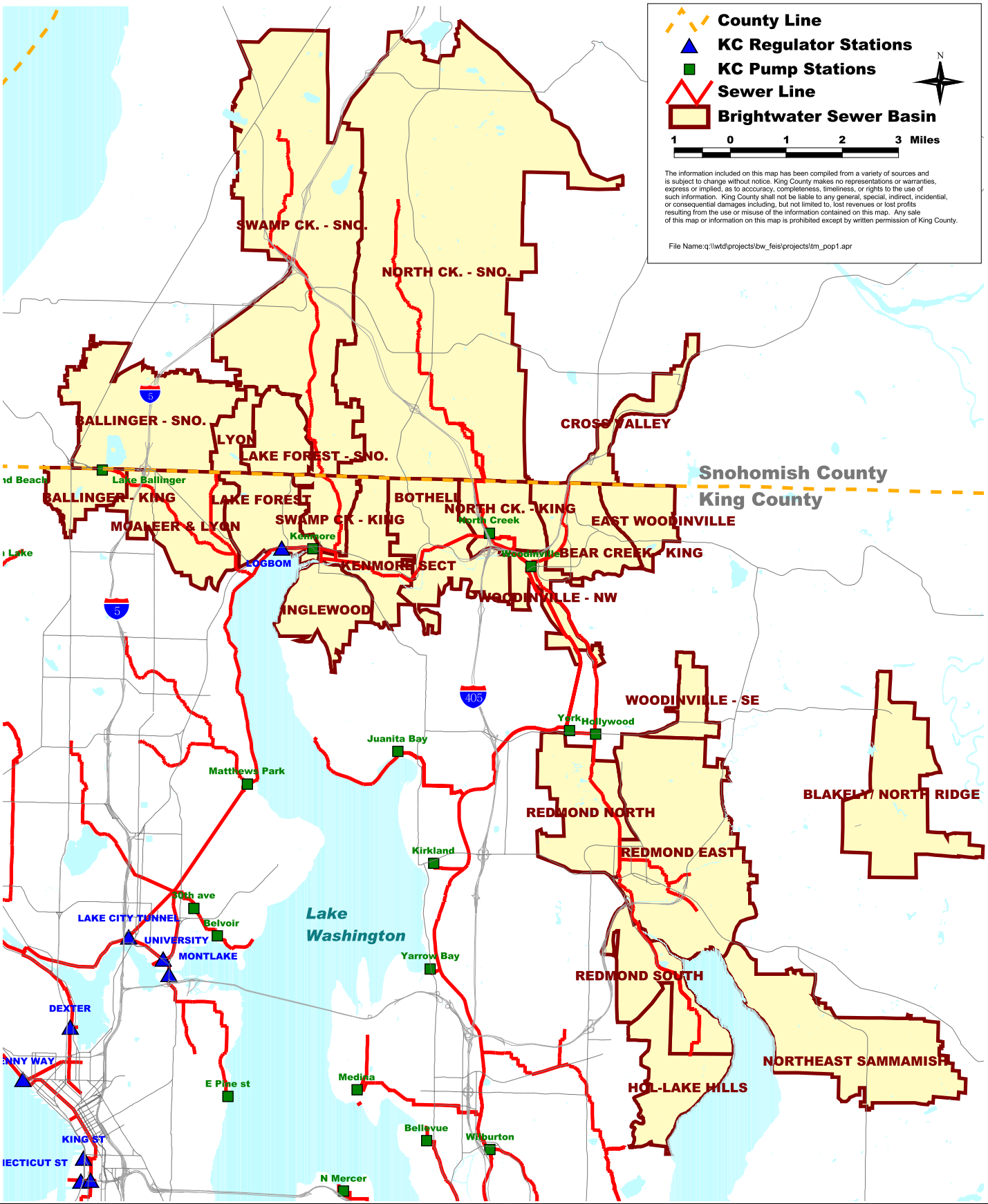

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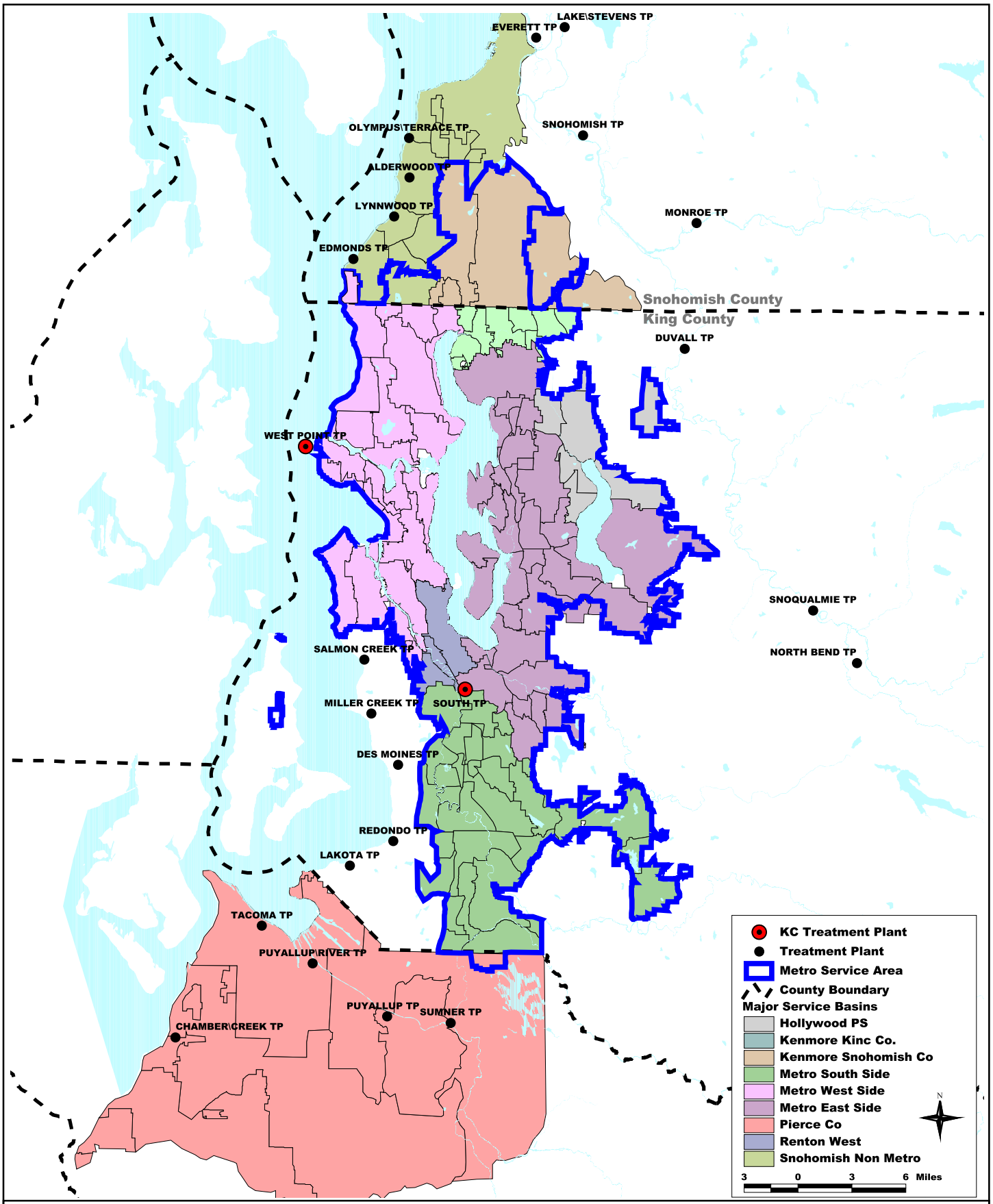
Figure 2

RWSP Service Sewer Basins

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM



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File Name:q:\wtd\projects\bw_feis
\proejcts\tm_pop2.apr

Figure 3

Total Regional Wastewater Basin System
Major Service Basins Division
BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

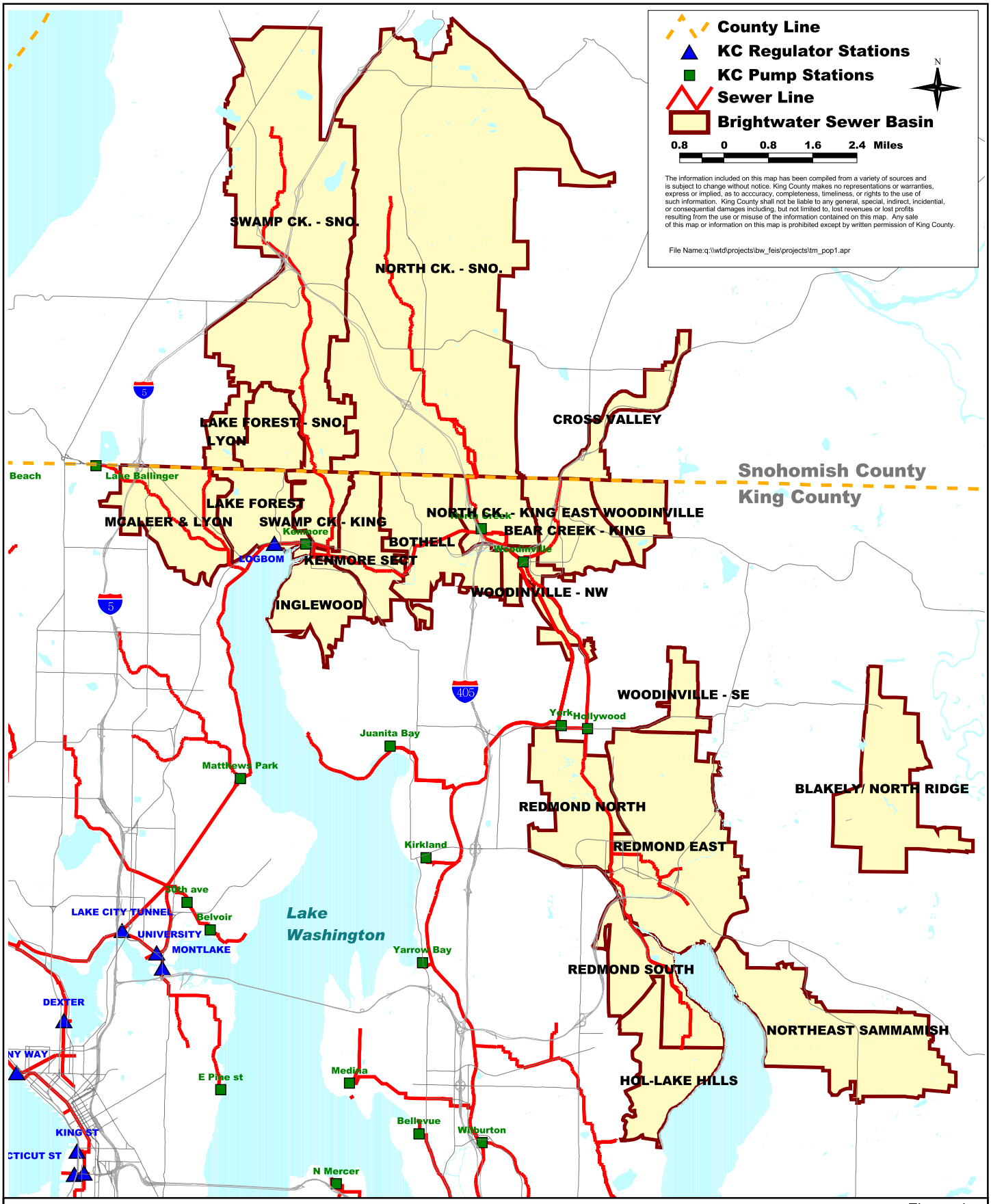

Figure 4

Sewer Basins within Brightwater Service Area to be directed toward Brightwater Treatment Plant Beginning 2010 - Reflected in Draft EIS

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

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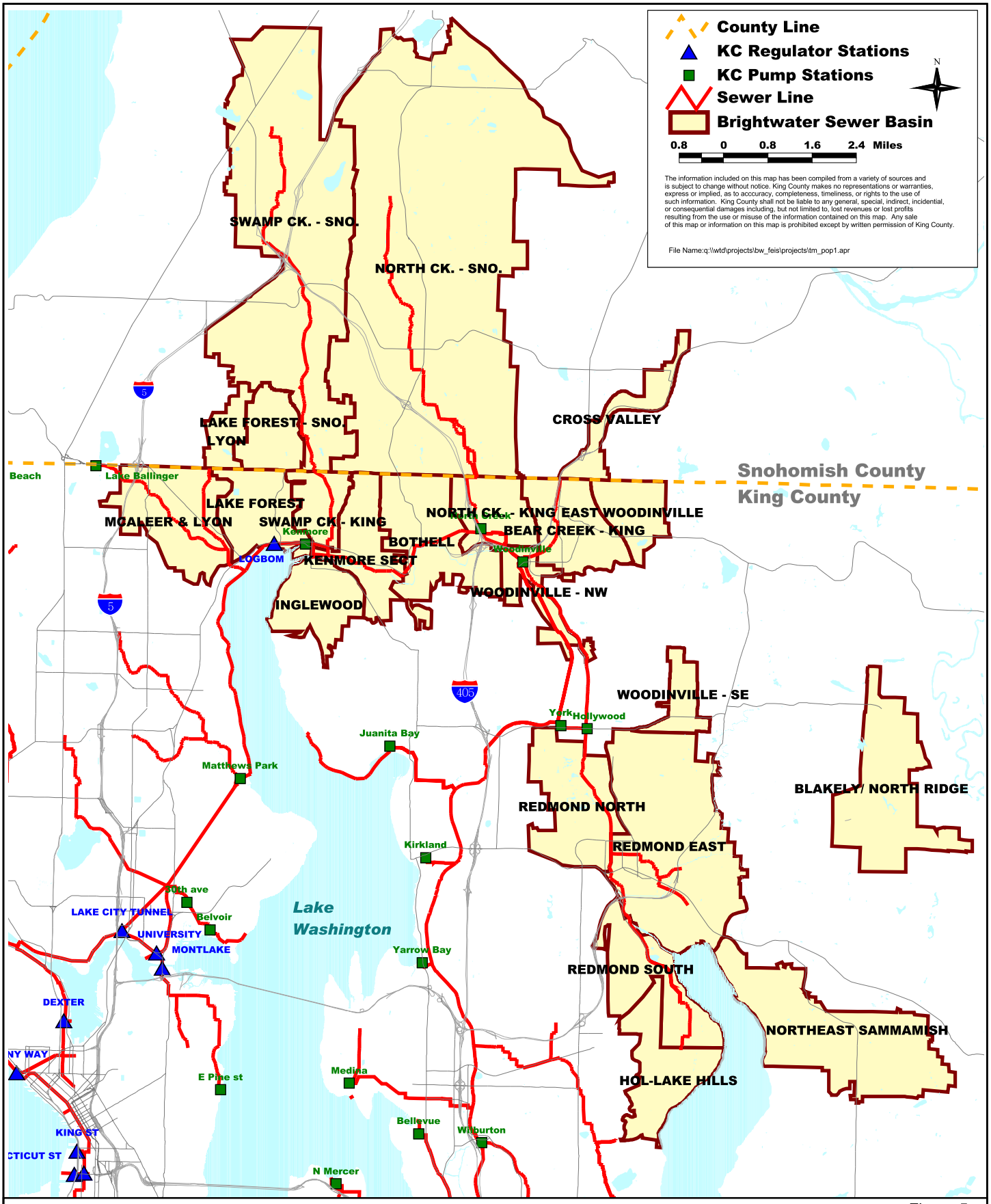

Figure 5

Sewer Basins within Brightwater Service Area to be directed toward Brightwater Treatment Plant Beginning 2020 - Reflected in Draft EIS

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

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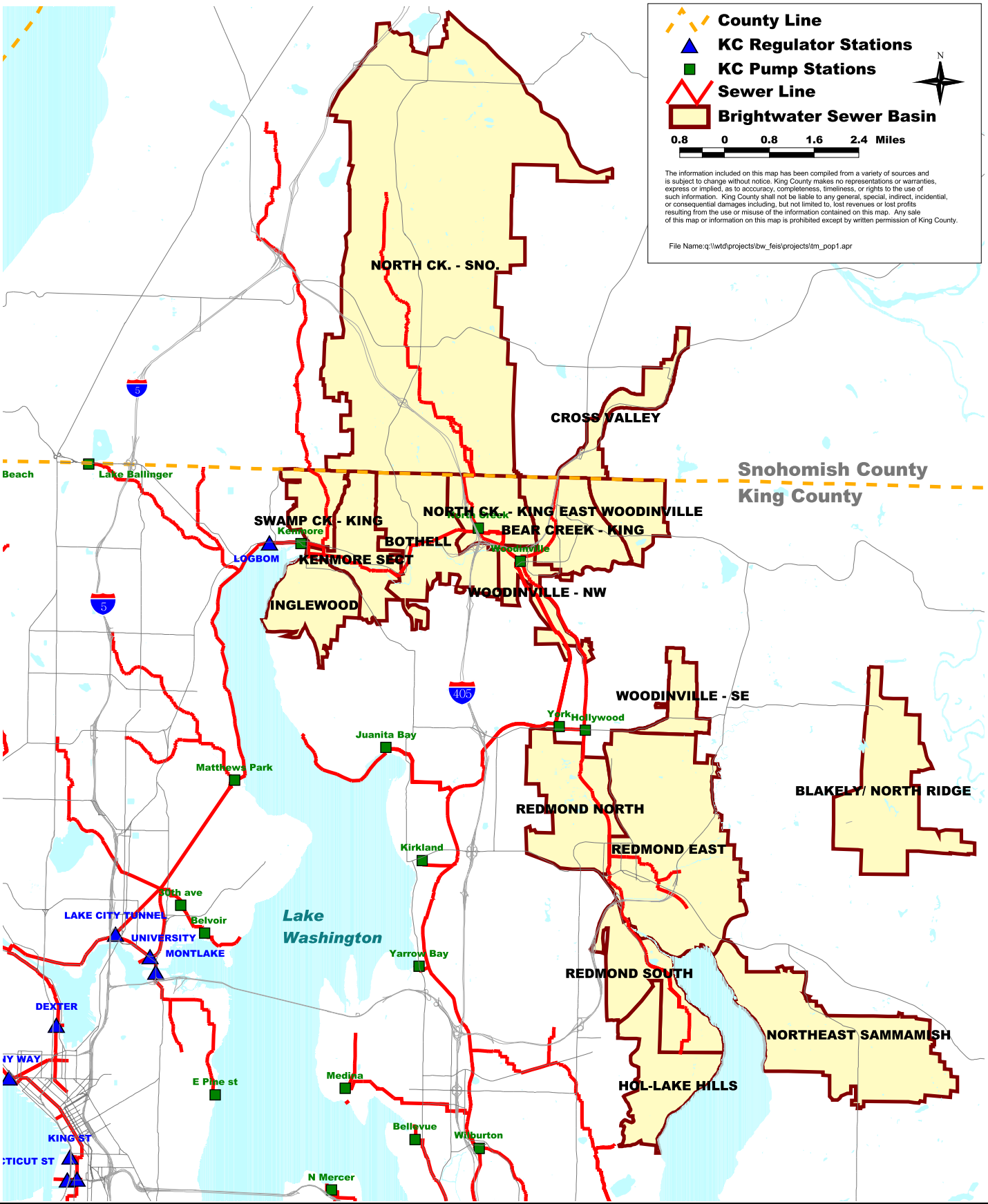

Figure 6

Sewer Basins within Brightwater Service Area to be directed toward Brightwater Treatment Plant Beginning 2030 - Reflected in Draft EIS

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

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Wastewater Treatment
Division

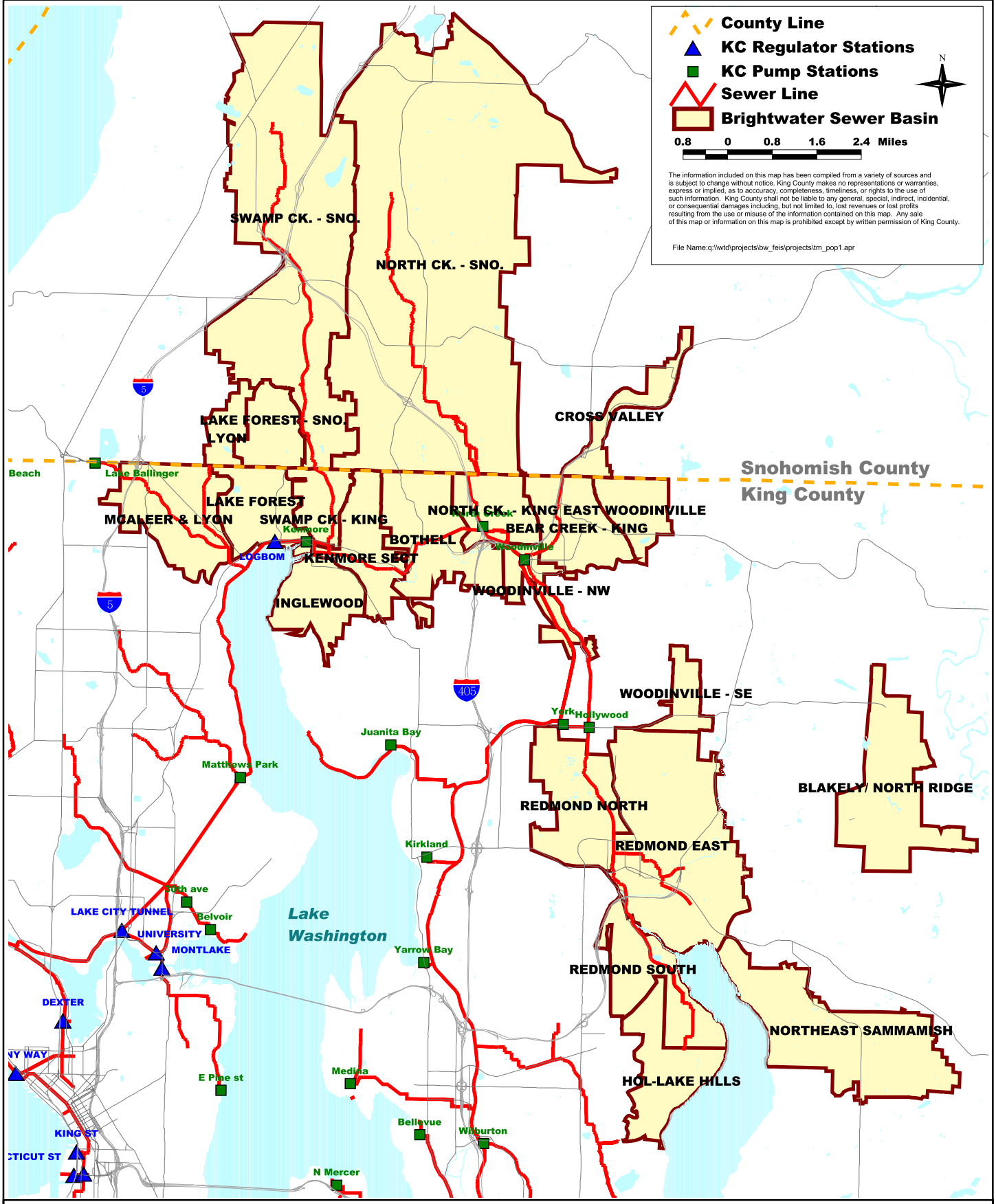

Figure 7

Sewer Basins within Brightwater Service Area to be directed toward Brightwater Treatment Plant Beginning 2050/Saturation- Reflected in Draft EIS

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

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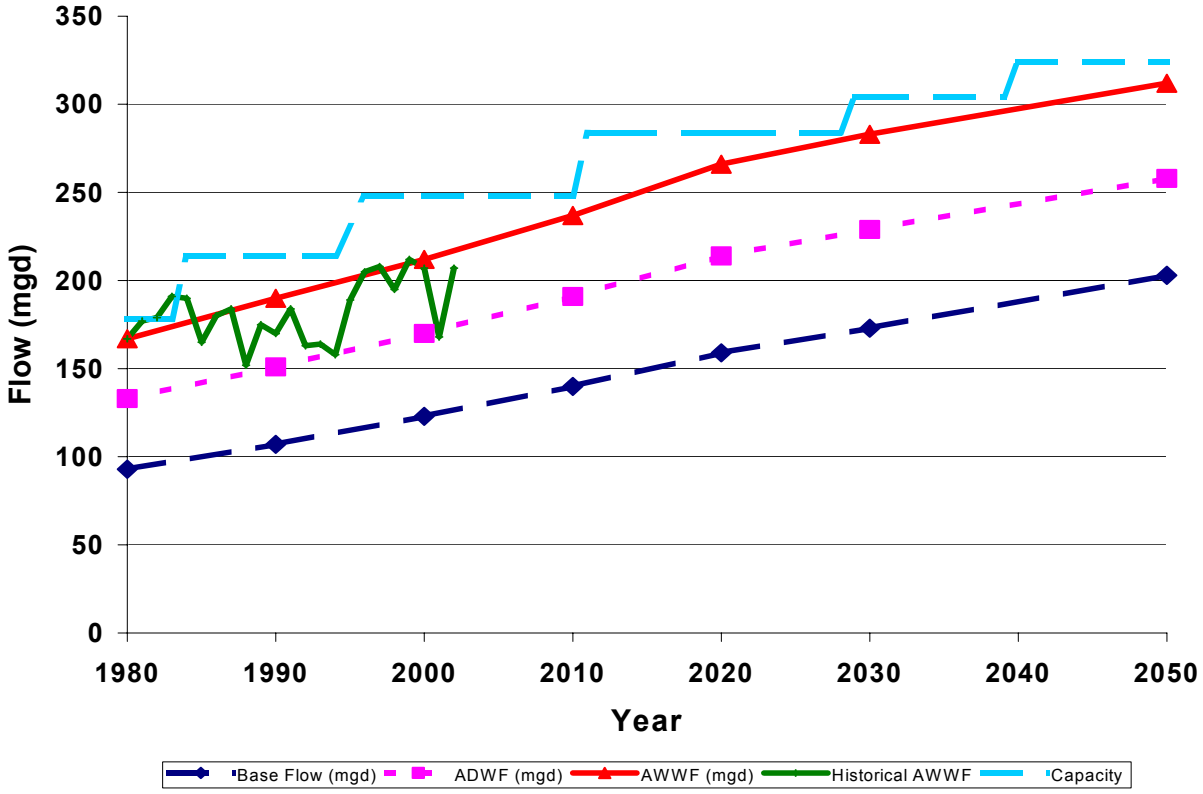

Figure 8

1998 RWSP Projection of Estimated Flows and Capacity Need

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

File Name: KC flow projection fact sheet final_final.doc

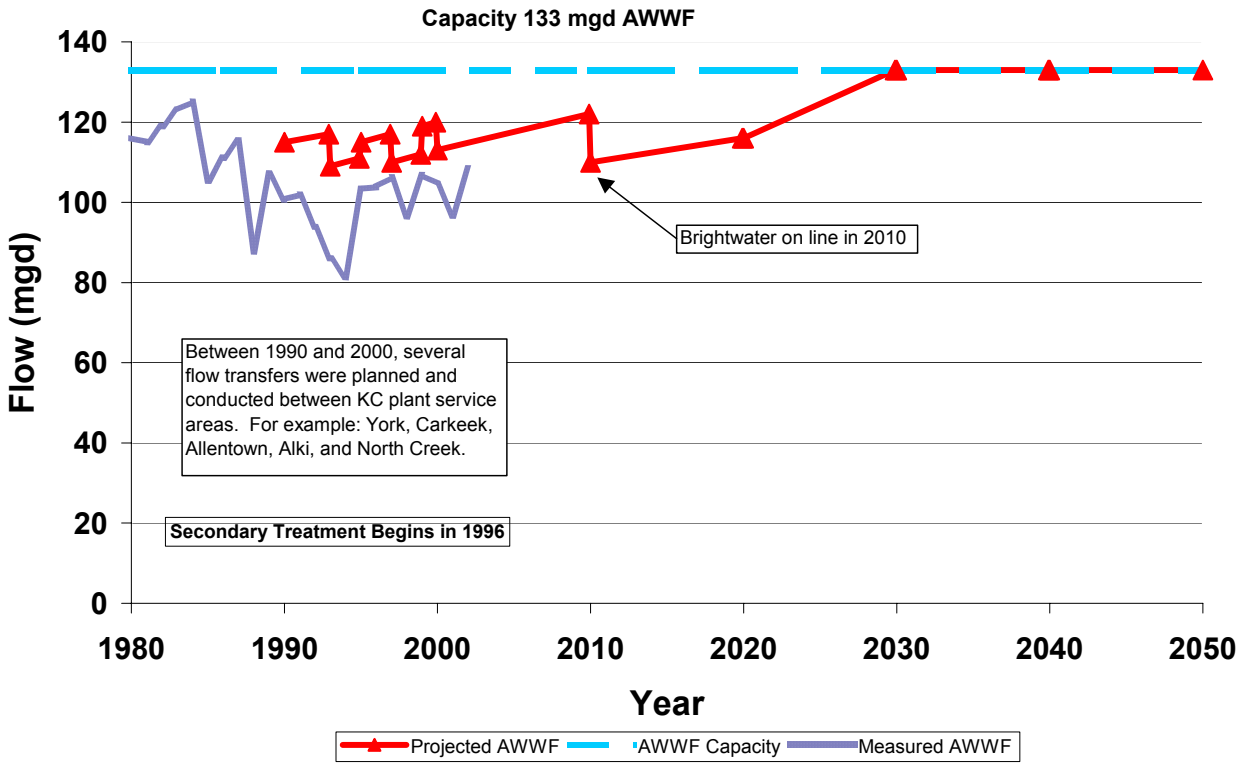

Figure 9

1998 RWSP Projection of West Point Average Wet Weather Flows & Capacity

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

File Name: KC flow projection fact sheet final_final.doc

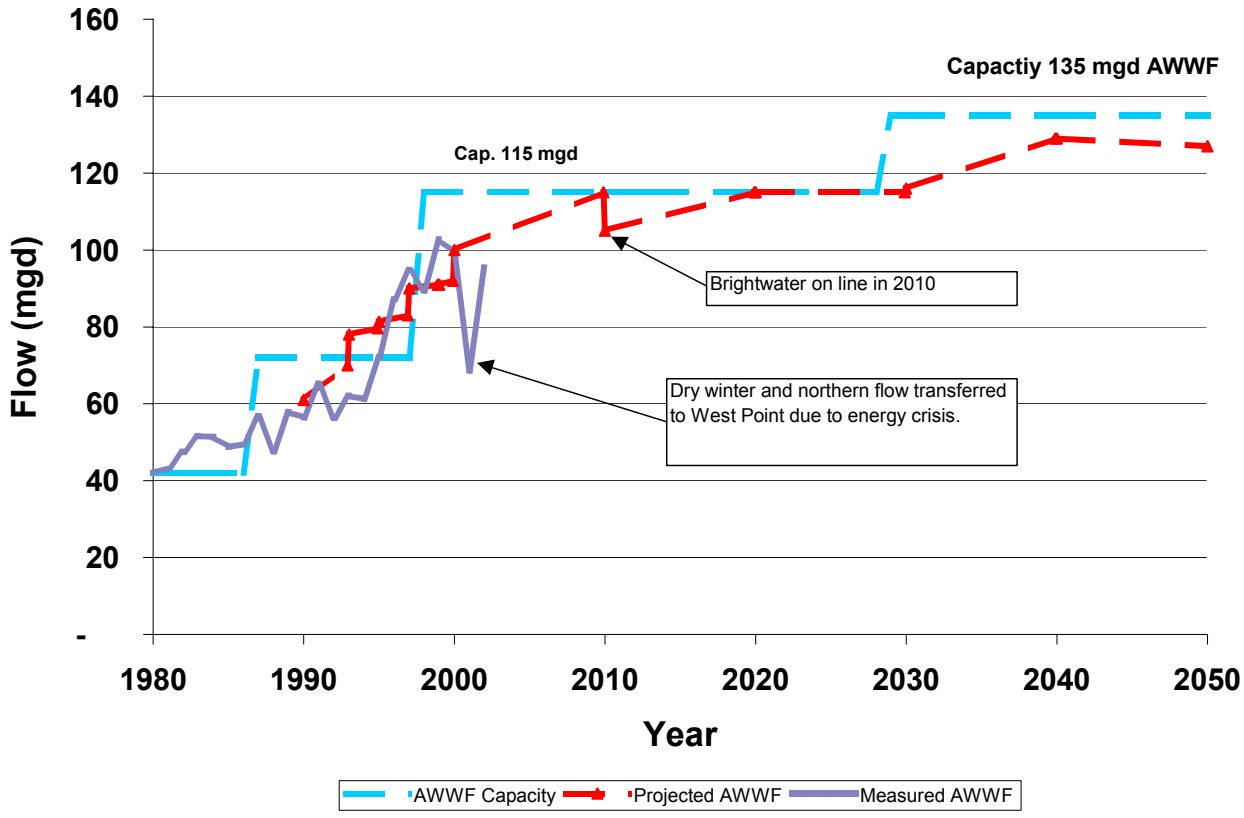

Figure 10

1998 RWSP Projections of South Plant Estimated & Actual Flows & Capacity

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

File Name: KC flow projection fact sheet final_final.doc

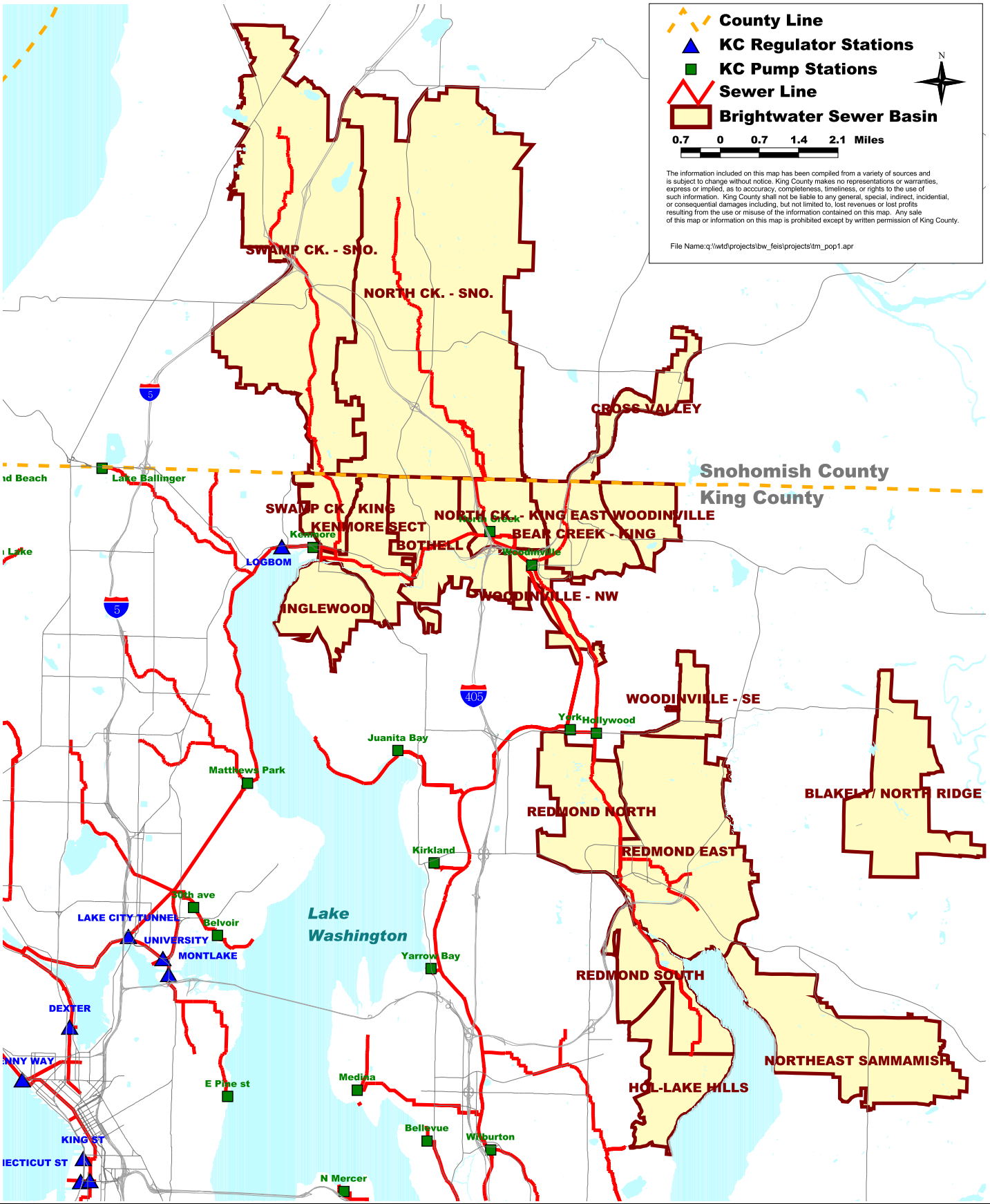

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Figure 11

Updated Brightwater Service Area

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

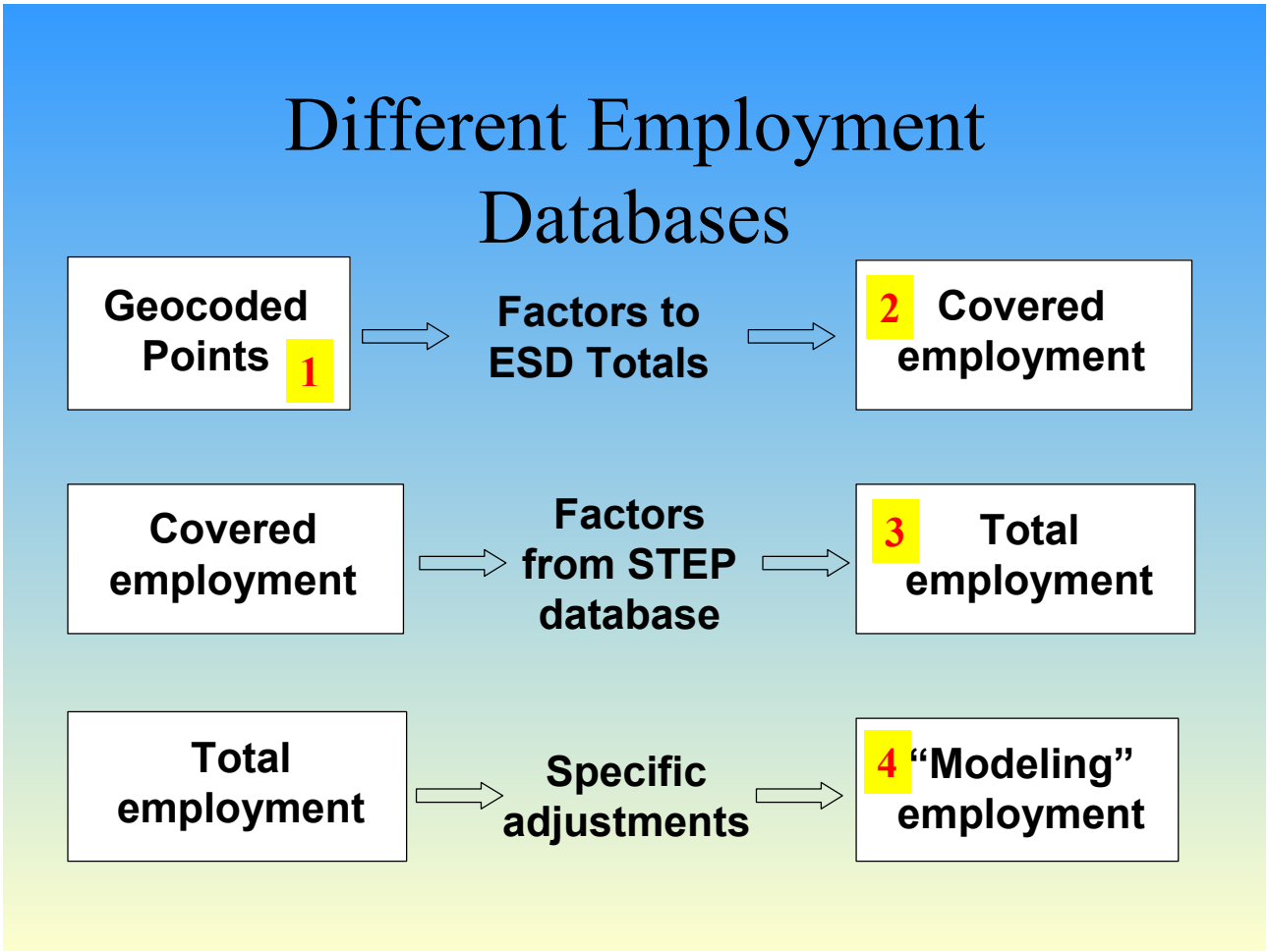
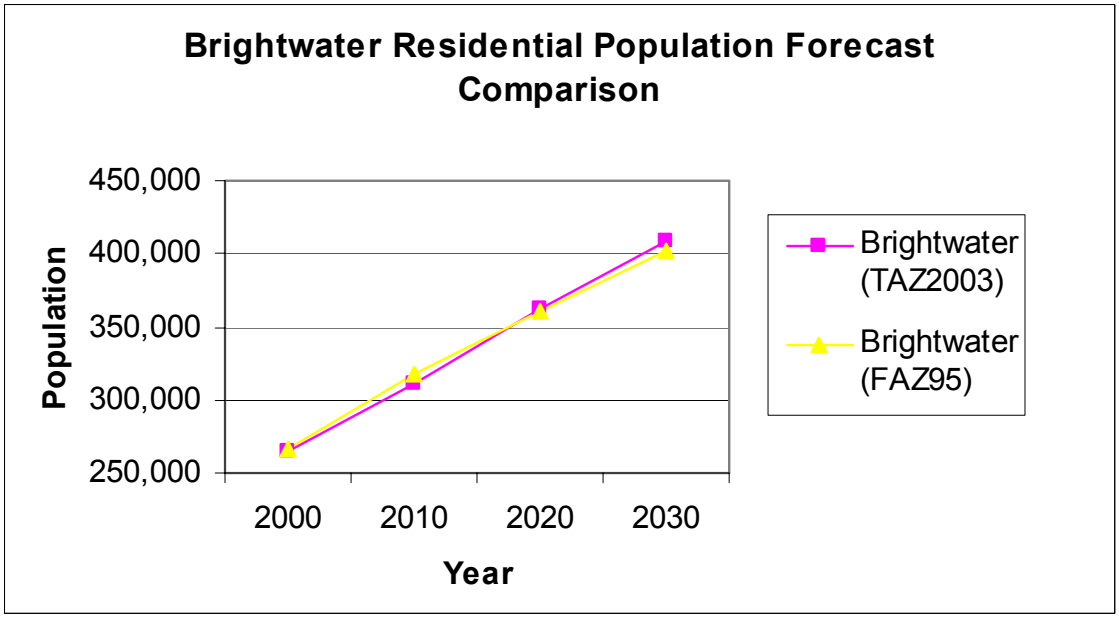


Figure 12

Visual Representation of PSRC Employment Forecast Process

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

File Name: Emp Dbase Dev Slides.ppt



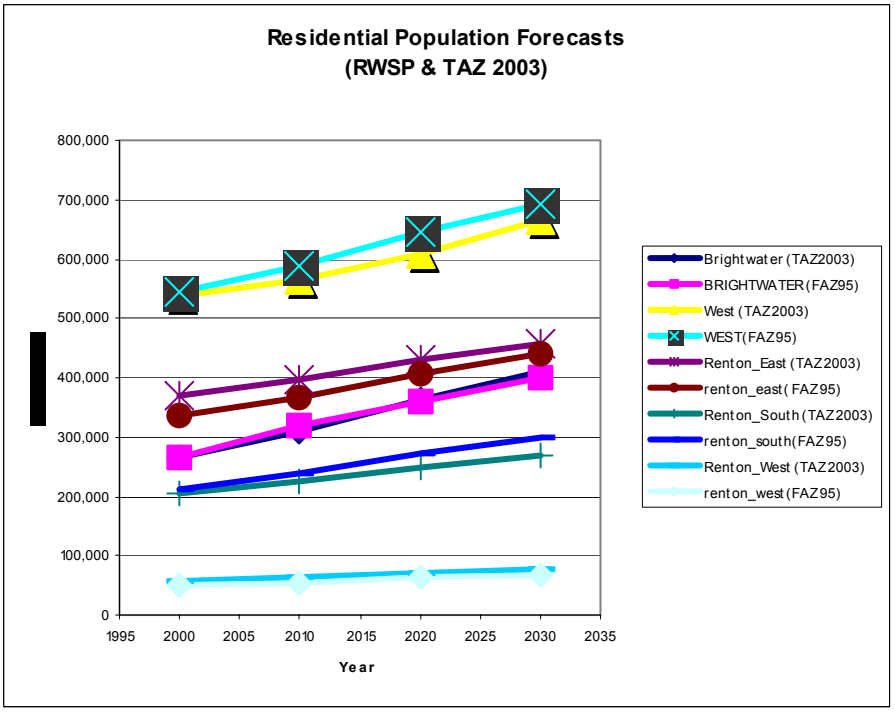
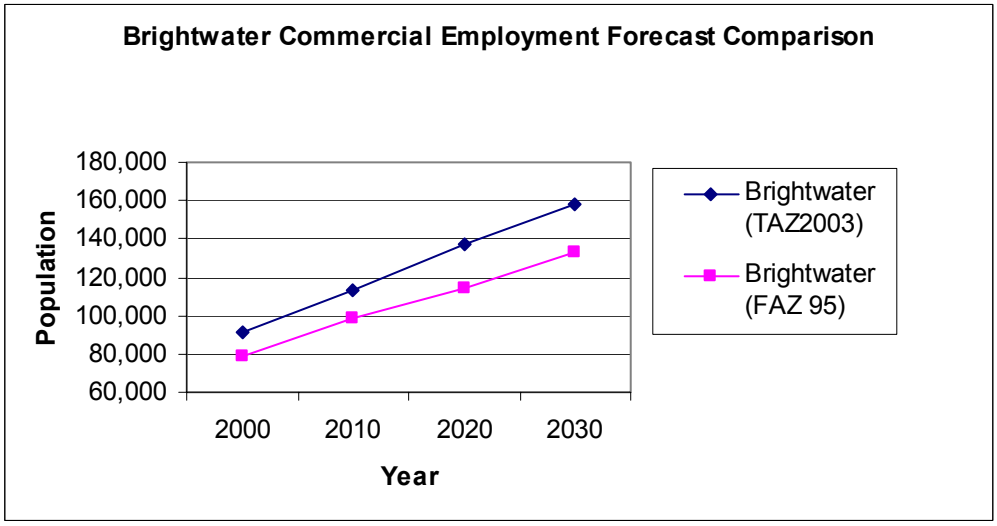


Figure 13

Comparison of Previous (FAZ 1995) & Current (TAZ 2003) PSRC Residential Population Forecasts within the KC Service Area

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

File Name: compare1_taz2003_snoflo95.xls



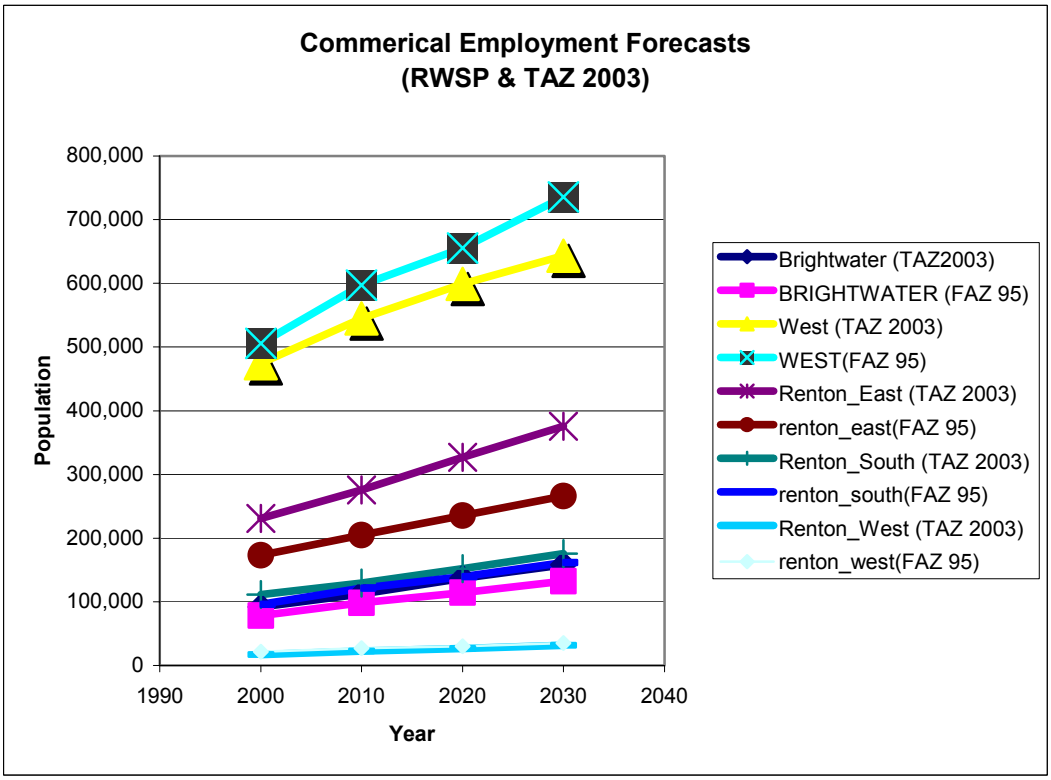
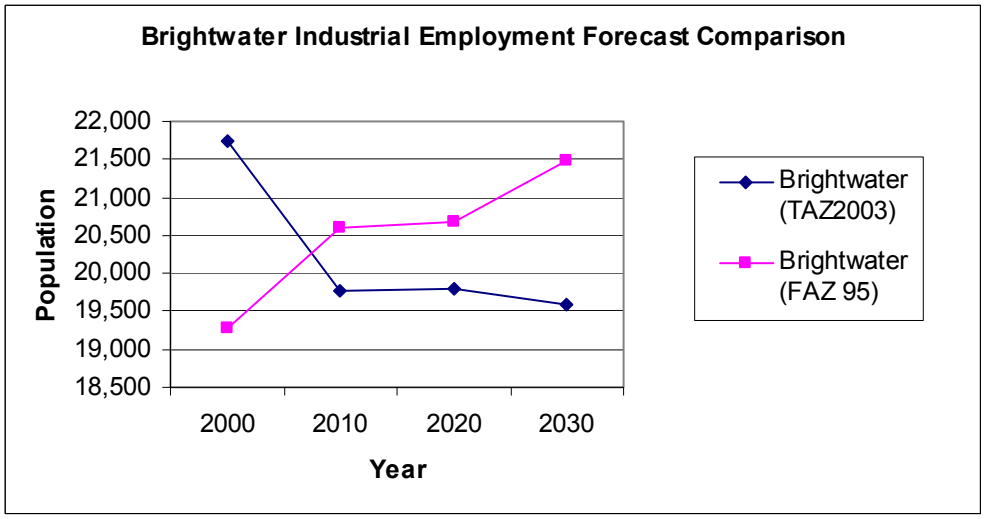


Figure 14

Comparison of Previous (FAZ 1995) & Current (TAZ 2003) PSRC Commercial Employment Forecasts within the KC Service Area

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

File Name: compare1_taz2003_snoflo95.xls



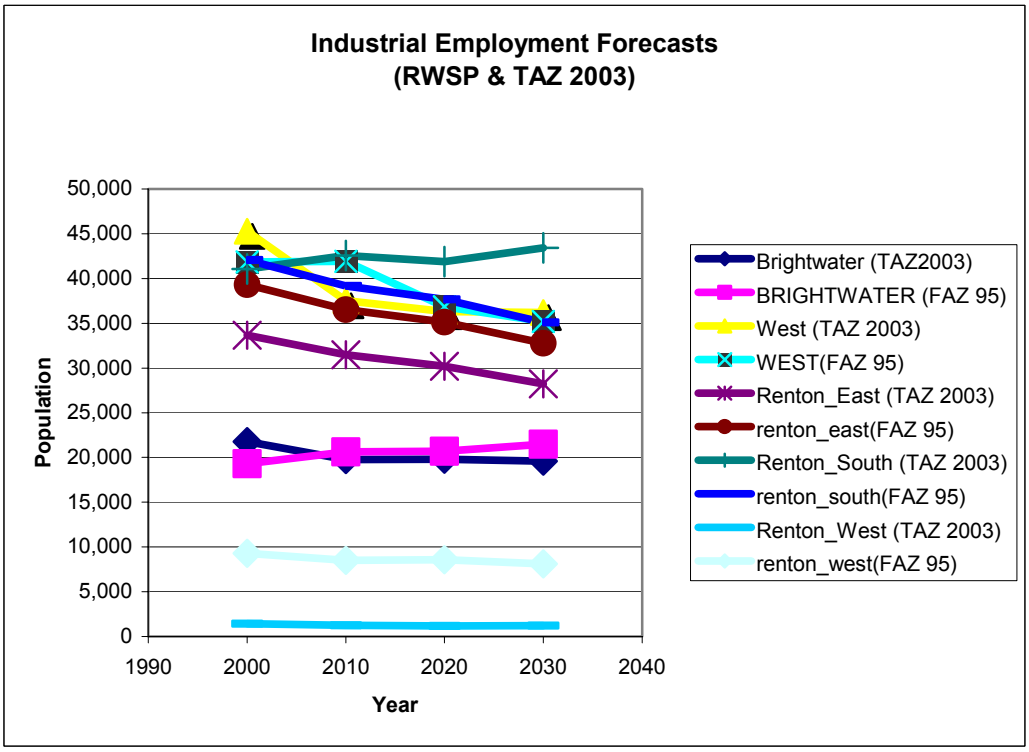


Figure 15

Comparison of Previous (FAZ 1995) & Current (TAZ 2003) PSRC Industrial Employment Forecasts within the KC Service Area

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

File Name: compare1_taz2003_snoflo95.xls

Base Wastewater

PSRC

- Population/Employment by small area forecasts.
- 20-30 year population forecast

WTD

1. **Allocate to Drainage Basin**
   - **a.** Overlaying basin boundaries
   - **b.** Allocated based on area
2. **Define Who is Sewered**
   - **a.** Overlay local agency sewer maps
   - **b.** Sewered area defined
   - **c.** Identify current population sewered
3. **Project Population/Employment/ Sewered Areas**
   - **a.** Apply PSRC data for 20-30 year forecast
   - **b.** WTD projects extension of PSRC data
   - **c.** Assume unsewered are 100 % sewered by 2020
4. **Base Wastewater Flow**
   - **a.** Apply unit factors to projection
   - **b.** Population Employment Commercial-Industrial –Residential

I/I Flows

WTD

Current I/I data

- Flows measured by tributary basin
- Hydrologic and hydraulic models calibrated to flow data
- Flows at treatment plants are used to estimate current average I/I
- Hydrologic and hydraulic models estimate current peak I/I
- Expressed gallons/acre/day

Future I/I

- Add new sewered area
- Assume new area I/I same as existing I/I in the same basin
- Assume I/I increase 7%/decade for deterioration through 2030
- Expressed gallons/acre/day

Total Wastewater Flow
Sum of Base and I/I

Figure 16

Wastewater Flow Projection Process

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

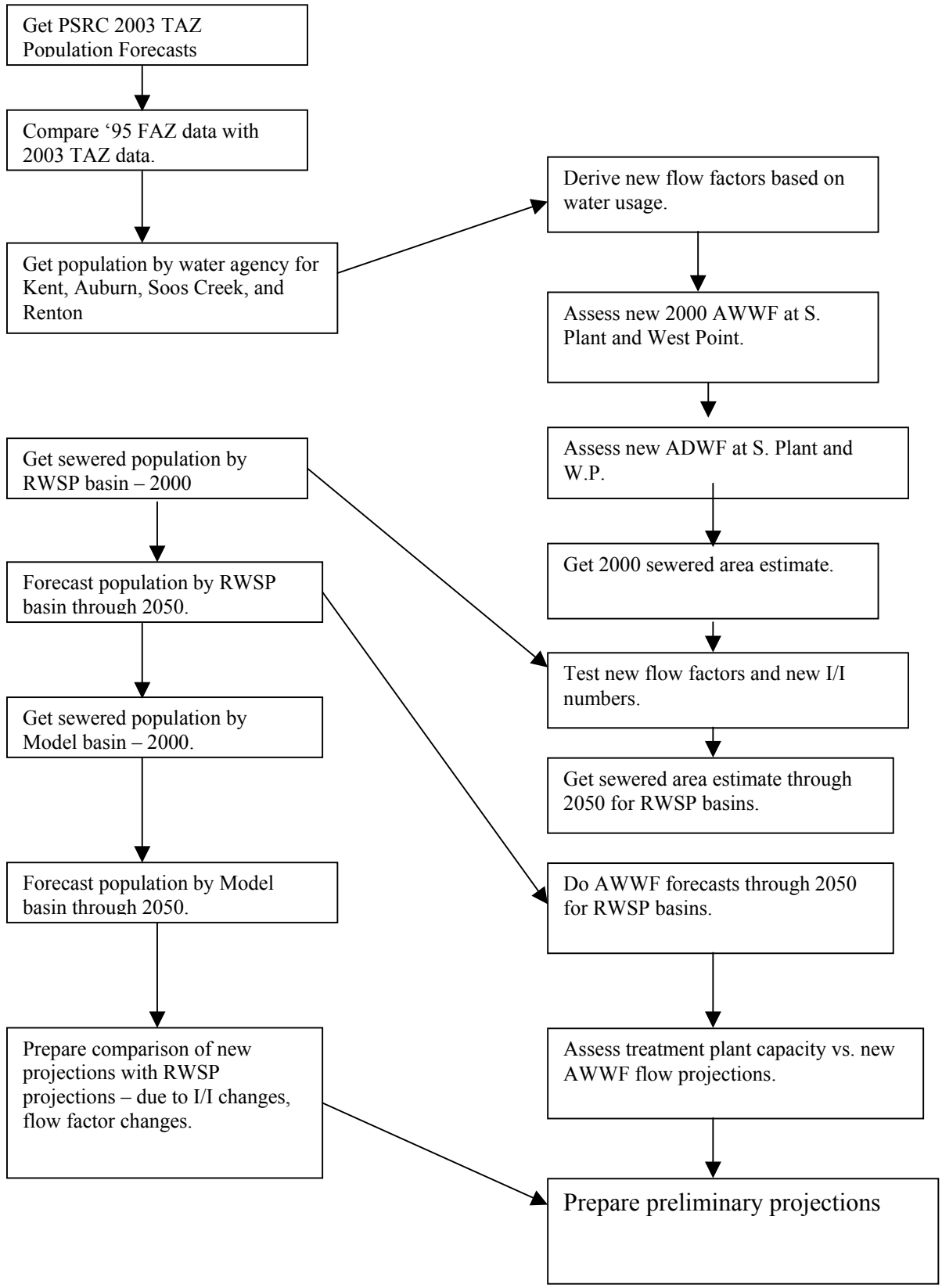


Figure 17

Brightwater Average Wet Weather Flow Projection Flow Chart

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

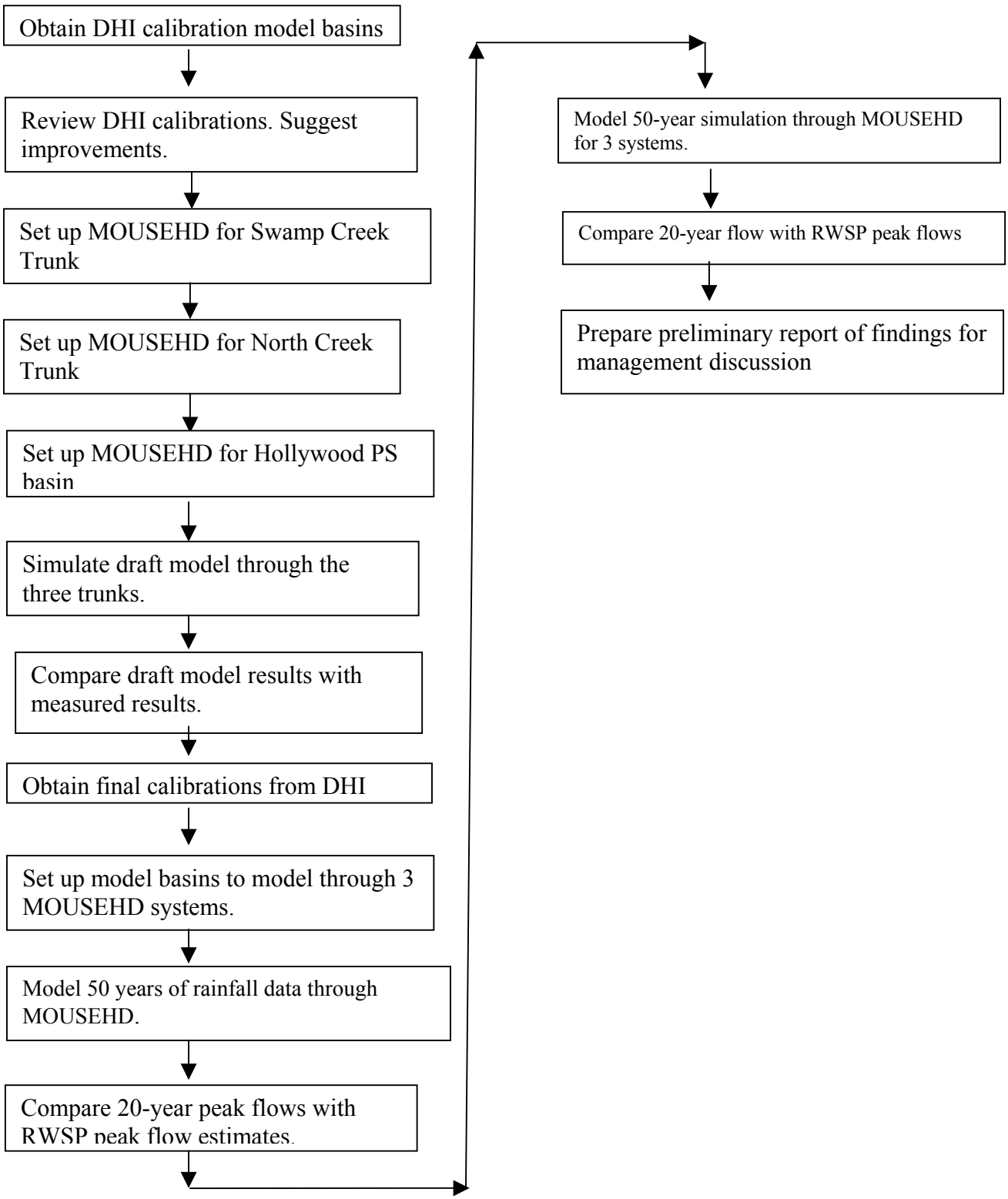


Figure 18

Methodology for Determining Peak Flow Estimates

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

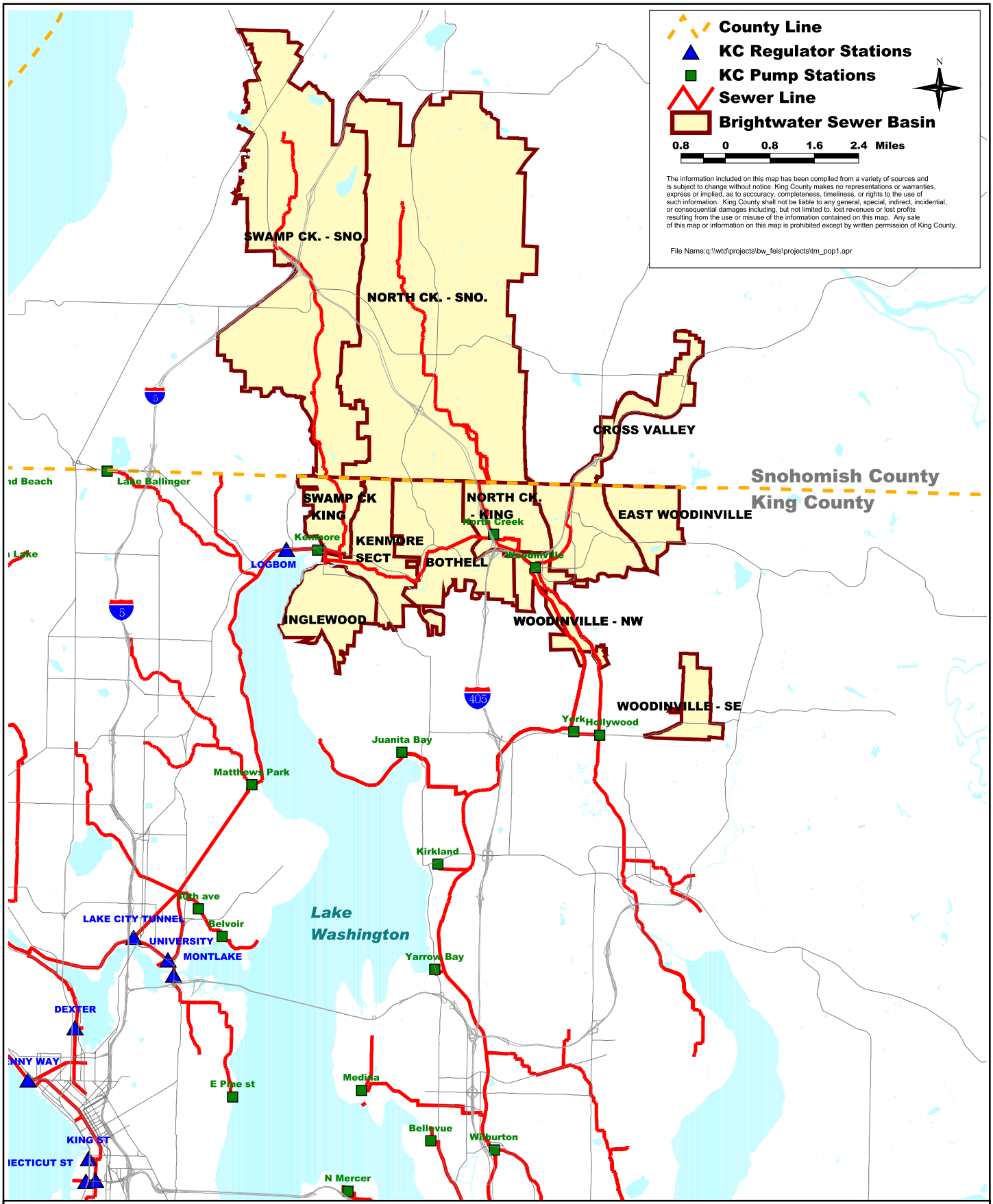


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Figure 19

Sewer Basins within Brightwater Service Area to be directed toward Brightwater Treatment Plant Beginning 2010

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

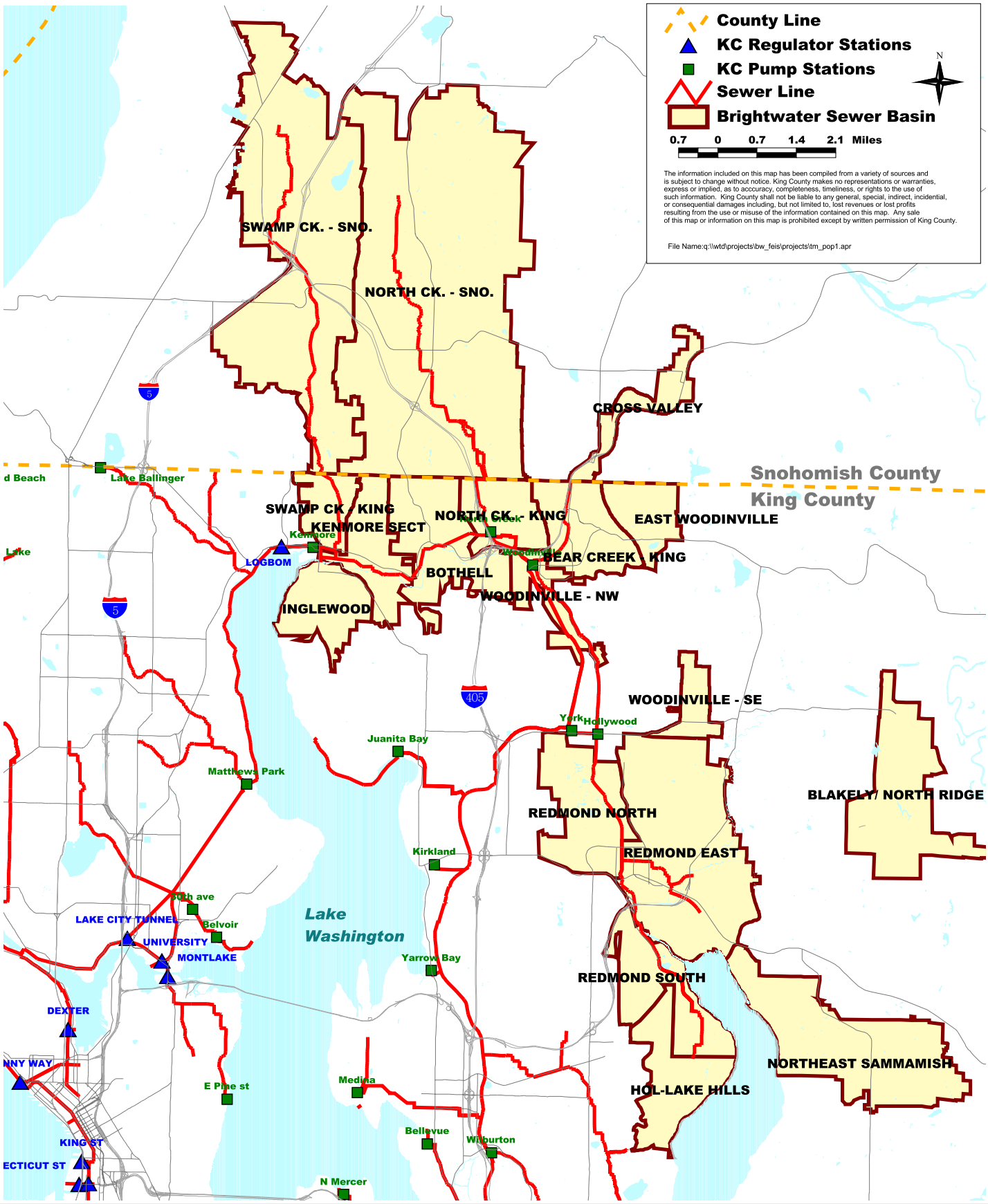

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Figure 20

Sewer Basins within Brightwater Service Area to be directed toward Brightwater Treatment Plant Beginning 2020

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

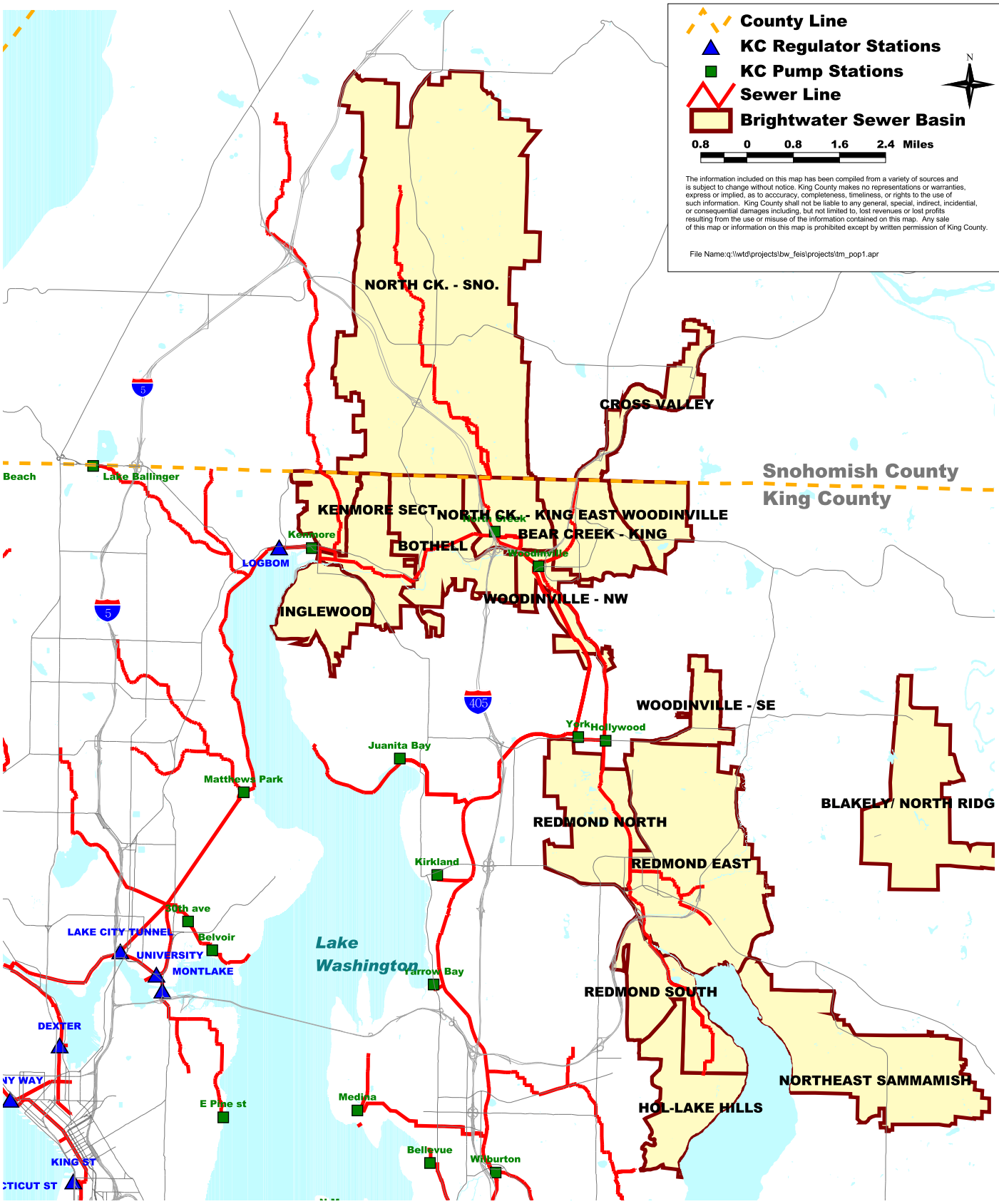

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Figure 21

Sewer Basins within Brightwater Service Area to be directed toward Brightwater Treatment Plant Beginning 2030

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

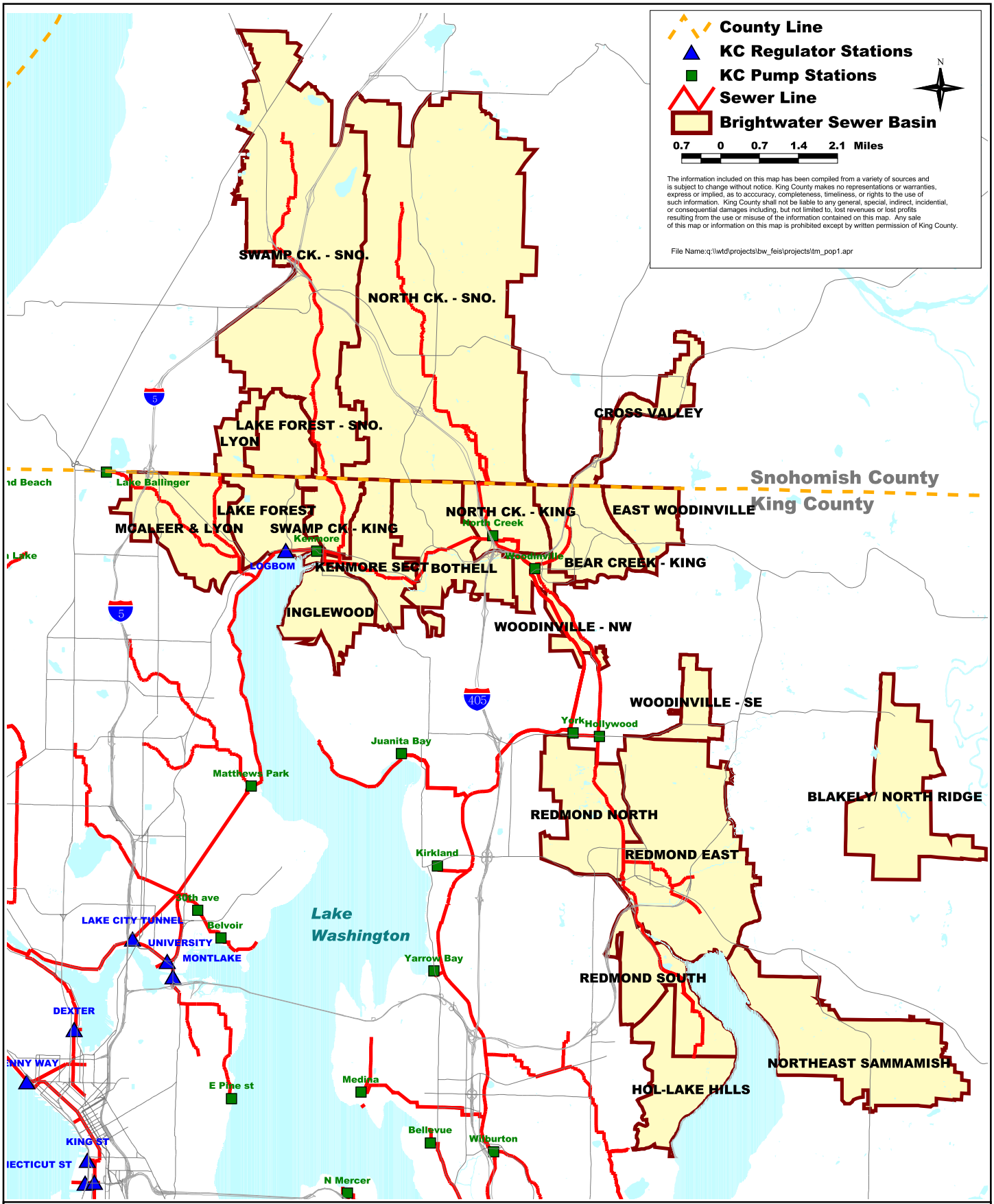

Figure 22

Sewer Basins within Brightwater Service Area to be directed toward Brightwater Treatment Plant Beginning 2050/Saturation

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

King County
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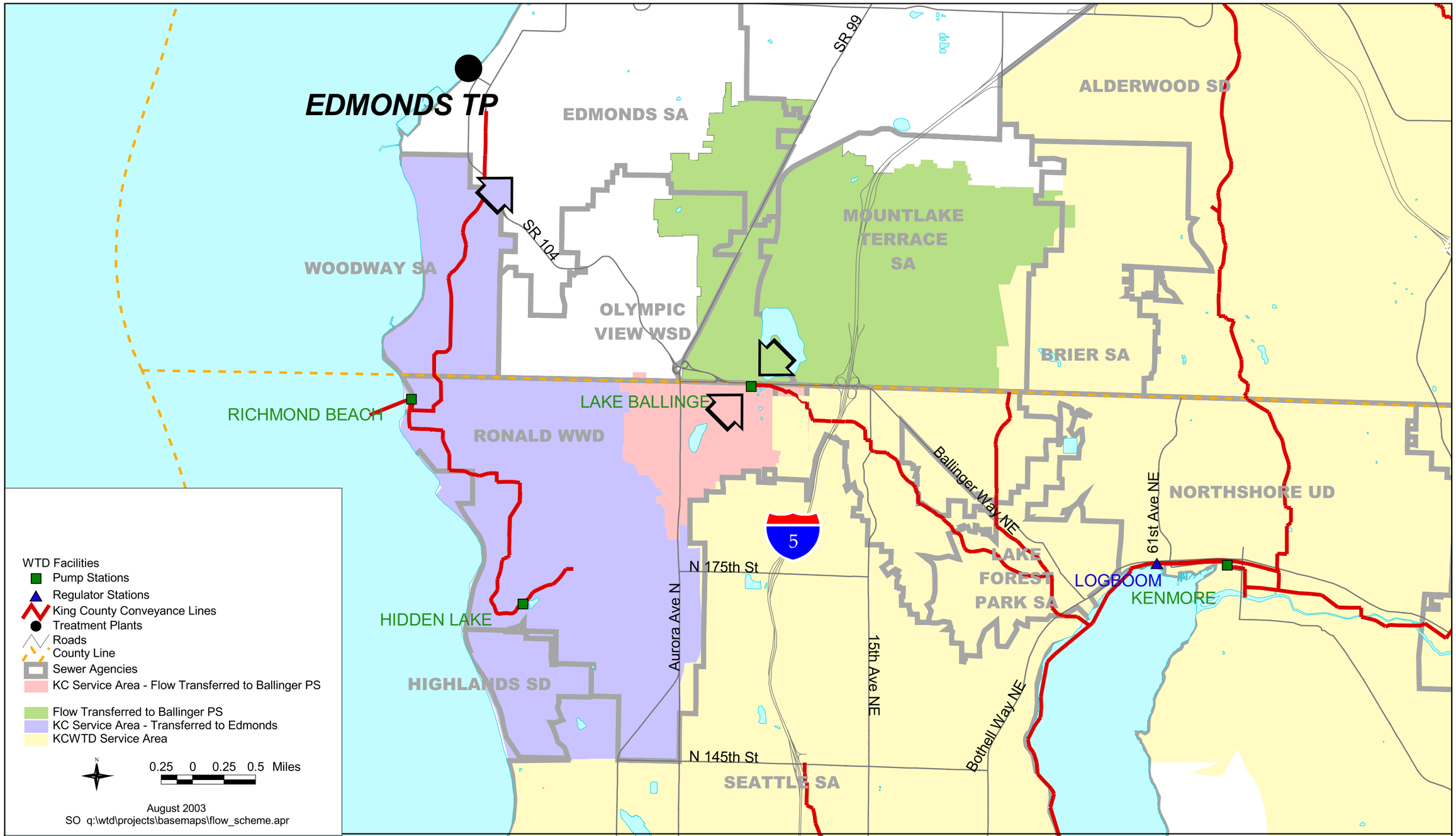
Natural Resources and Parks
Wastewater Treatment
Division



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Figure 23

EDMONDS / KING COUNTY FLOW TRANSFER

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM